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THE FIRST DAFFODIL.

AFTER watching it closely for four or five days, I have just found the first daffodil of the season wide open this morning, with a big humble-bee buried deep in its capacious throat, already rifling its little store of nectar, and dusting his body and legs with pollen which he will promptly carry away to fertilise one of its pretty sisters in some neighbouring garden. Though I have watched it like a child, I could not resist the childish temptation of picking it, and I have got it here before me now for dissection, poor thing, with my little pocket-knife, though it does not need much of a magnifying power to see all that need be seen of its structural arrangements. It is only a common wild English daffodil: the "daffy-down-dilly who came up to town in a yellow petticoat and a green gown," as the old nursery rhyme has it; and it has been simply transplanted hither from the meadow beyond the bourne; but it is as gay and bright a blossom as one could wish to see, for all that, besides being full of genuine scientific interest for those who care to look at it aright. Let me cut it straight down through the middle, so, and then you will understand better what it is driving at.

You see, the flower consists of a single amalgamated tube, with six lobes or points, and in between them, projecting from its centre, is a large circular crown, broadly tubular in shape, and brightly yellow, like the rest of the blossom, in colour. It is well to begin at the beginning; and so we may first ask why it is six-lobed? The answer is, because it is one of the monocotyledonous plants. That is a very long and technical word—I am half afraid our English-speaking editor will cut it ruthlessly out—and, indeed, I wish it were shorter and simpler; but at present, unhappily, I know of no other that will efficiently supply its place. Let me try to explain it. Many years ago, when flowering plants first appeared upon the earth, they began to diverge into two principal divisions, from one or other of which all our existing flowering kinds (except only the cone-bearing pine family) are ultimately descended. One of these primitive groups had two seed-leaves in each seed, the other had one. There are a great many other differences between the two tribes, but these are the most constant; and it is to the last tribe that the daffodil belongs. Now, so far as the flower is concerned (and it is with that part of the plant alone that I am going to deal to-day), the widest original difference between the two great divisions was this—the plants with two seed-leaves had their parts arranged in whorls of five, while the plants with one seed-leaf had them arranged in whorls of three. Thus the typical flower of the first class has five sepals, five petals, five stamens, and so forth; while the typical flower of the second class has only three of each. In the course of time, however, this original difference has become greatly masked; for many flowers of the first kind have lost one or two of their petals or stamens, by coalescence or otherwise; while many flowers of the second class have doubled their numbers in one part or another. Nevertheless, in most cases, we can even now trace, in some way or other, the steps which connect the existing form with its primitive ancestor; and it is still true that the two types are broadly marked off from one another, as the five-rayed and the three-rayed forms respectively.

Now, the daffodil is a very advanced and highly-modified development of the three-rayed type. The artificial family to which it belongs in the present somewhat irrational arrangement of flowers is that of the amaryllis kind; but we shall understand it better if we look first at its near neighbours of another family, the iris and crocus group. These plants in some of their modifications, such as the common yellow flag, are very simply three-fold in their ground-plan. There are three seed-cells to the pistil in the centre; then there are three stamens outside them; next, there are three petals; and, last of all, there are three large spreading sepals in the outermost whorl. But in the crocus, the three petals and three sepals are indistinguishable, and have coalesced into a single tube, so that the flower seems to have a united corolla of six lobes. Now, in the amaryllis family, to which the daffodil belongs, we get the same sort of tendency carried a little further. Instead of having only one row of three stamens, the members of this group have two rows, thus making a total of six—for, though no mathematician, I will fearlessly venture upon so much arithmetic as that. In the simpler amaryllids, such as the snowdrop, the confusion goes no further than this single step; and we get, first, a three-celled pistil in the centre; next, six stamens in two rows outside it; then three small green-veined petals; and last of all, three large pure white sepals. Here the original three-fold symmetry is hardly at all masked by the occurrence of a double set of stamens; while the petals and sepals are quite separate down to their very base, without any sign of union or coalescence. I don't say they never have been united; indeed, I have certain grave doubts of my own upon that head, connected with what botanists call their inferior ovary; but I'm not going to mention that point to-day, lest I should tell you too much about them all at once, and so spin out my paper to an unconscionable length. For the present, it must suffice to notice that we still possess amaryllid flowers in which the primitive arrangement by threes is even now distinctly visible.

The daffodil, however, has got beyond this early stage, and has undergone so very much modification that its primitive aspect is almost entirely masked by its acquired traits. When I slice across its ovary, or embryo fruit, it is true, I can see that it still consists of three cells, produced by the union of the three originally separate pieces; but with this exception, all its parts now appear to be in sixes rather than in threes. There are six pollen-bearing stamens, produced by doubling the original three; and there are six

lobes to the corolla, produced by the coalescence of the three petals with the three sepals, so as to form a single united tube. The object of this coalescence is easy enough to understand. As in the harebell, the daisy, and so many other flowers, it has been effected by the selective agency of humble-bees and other insects, like the one whom I found buried so deeply in its throat this morning. The tubular form, with its stamens hanging out from the side, ensures the fertilisation of the flower much better than the system of open petals; and so it has been brought about by the fact that any variation in that direction was unconsciously favoured by the insects, while variations the other way were universally neglected. But while many other plants have hit upon this same device of coalescence, few have carried it so far as the daffodil. In the first place, the tube in the five-rayed flowers is formed out of the petals alone; but in the three-rayed flowers, the petals are too few in number to make a sufficiently wide tube, and so the sepals or calyx-pieces are joined with them in producing the desired result. Thus we can trace a gradual progress from flowers like the iris and snowdrop, where the sepals are distinctly different from the petals, through flowers like the wild hyacinth, lilies, snowflake, and flowering rush, where all six pieces are equal and similar, to flowers like the crocus, meadow saffron, and daffodil, where the six pieces are united together into a long tube. But, furthermore, and in the second place, the daffodil and the others of the narcissus kind have done more than the mere ordinary tubular blossoms, inasmuch as they have produced a singular outgrowth in the shape of the crown or cup, which forms, as it were, a vestibule to the tube, and thus still better ensures the proper fertilisation of the flower. In some of the pink tribe (amongst the five-rayed flowers) we get a scale or parapet on each petal in somewhat the same way; but in the daffodil and its allies the crown is united and circular, like the tube, though one can still trace six wavy lobes or sinuosities on its edge. In some exotic members of the narcissus group the crown is very small and rudimentary, and is brilliantly coloured with red or orange, so that it seems rather to act as a honey-guide for the bees than as an additional aid to fertilisation; but in the wild English daffodil it has reached a very high state of development, and occupies at least half the entire length of the blossom.

One word more as to its colour. The daffodil is a pale yellow, and it apparently depends mainly for impregnation upon the visits of diurnal insects. Hence it is quite scentless, for its large size and brilliant colour suffice to attract quite enough visitors, without any necessity for the extra allurement of sweet perfume. But many of the southern species, like the jonquils of our flower gardens, have pure white petals, and possess a very powerful jasmine odour. Such white, strong-scented flowers always depend, in part at least, upon night-flying moths, which are largely attracted by perfume; and, of course, no colour can be so well perceived in the dusk of evening as a pure glossy white. Hence the difference in hue between the two kinds. At the same time, the southern varieties are also fertilised by day-flying bees, and for these the frill of the crown is prettily fringed with brilliant orange. Each insect selects the plant that suits it best, and their joint selection has thus produced the snowy petals and exquisitely-coloured cup of the garden jonquil.

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A STUDY OF MINUTE LIFE.

By Henry J. Slack, F.G.S., F.R.M.S.

No. II.

THE editor will, it is hoped, allow the writer to explain that through the accident of his not receiving a proof for correction, many typographical errors appear in the last paper. The principal are, "cilian" for *cilium*, "injurious" for *in infusions*, in the sixth line from the bottom of the first column; "divided" instead of *directed*, eleventh line from the bottom of second column; and "analysis" for *analogy*, eighth line, p. 372.

If we were engaged in tracing life from its simplest modifications upwards, we should now speak of those objects, such as amœbæ, which are composed entirely of small masses of protoplasm, not built up into any positive structure. Some notice of these is reserved for a future paper, but it is best for the student to begin with objects that can be obtained for certain, without difficulty, and which are easy to observe. It may, however, be mentioned now that amœboid creatures, in their ordinary and simplest state, have no permanent distinction of parts. They put forth prolongations and draw them in again; portions that were outside get inside, as they move on in a slobbery way, and they swallow their food, not through any special aperture, but anywhere, by flowing all round it.

It is not uncommon to hear people talk about "homogeneous protoplasm," but as there is, and can be, no such thing, it is not correct to describe any amœboid object as composed of it. Life is only manifested by the co-operation of divers matters, highly complex in chemical constitution, and able to perform different functions. The ciliated infusoria, of which the Paramecium, spoken of in the former paper, is a good example, is a little bag of skin sufficiently firm to support the cilia, and full of the protoplasmic material. When we examine this material, wherever it is found in a living state, we see a vast number of particles in a viscid fluid. Their optical aspect suggests that they are not all alike in molecular structure; and if their extreme minuteness did not render it impossible to separate them for analysis, we should find they varied in composition. Lumping altogether, particles and viscous fluid, the constituents of protoplasm are found to resemble those of the white of an egg. It belongs to a group of substances found in all living things, and which carry on the chief vital work. Carbon, hydrogen, nitrogen, oxygen, sulphur, and phosphorus all combine to build up the molecules of this material, and the compound is in a state of such delicate equilibrium that it is easily modified or decomposed.

The Paramecium, and similar creatures, take their food in by a mouth, and in the early stages of knowledge concerning them, the great German naturalist and microscopist, Ehrenberg, thought they possessed a multiplicity of stomachs, because the food particles were dispersed in many little spaces. Their processes of digestion and assimilation are probably carried on without the help of special organs, though, no doubt, the particles seen in the protoplasm have the power of performing different kinds of work. The infusoria will not swallow *everything*, but their selective faculty is very small, and they readily take in particles of indigo or carmine, floating in the water about them, although they are of no use to them as food. Microscopists have long been fond of feeding them in this way, as the colouring matters can be traced inside the little animals. The cilia near the mouth bring all sorts of objects floating in the water towards it, and other cilia make an inward current to suck in what the creatures want. The appearances often seem to support the many-stomached, or polygastric, theory, but the vacuoles in

which the food-particles assemble are not constant in their position, and certainly do not possess any firm walls. Although the vacuole has not the structure of a vessel, when food-particles are assembled in its little open space, it acts just like a real stomach, and we must conclude that fluids specially adapted for the work of digestion are prepared by some of the visible granules and poured into it. The nutritive products of the digestion diffuse themselves through the soft moist mass of the creature, and the useless and used-up matters are excreted, in many species through a definite anal aperture.

The organs of these transparent and minute creatures, when they have such, are often impossible to trace. Paramecia, and many others, for example, have a contractile vesicle which expands as if filling itself, and then contracts rhythmically, and it is supposed from the analogies offered by larger creatures, that these vesicles, whose walls are invisible, are connected with a series of tubes through which fluids are impelled for both respiratory and excretory purposes.

However small may be the creatures and their particles of food, the composition of the latter, no doubt, resembles that of higher animals, and has to be digested and assimilated by a succession of similar processes. The microscopic plants supply complex nitrogenous as well as starchy materials, and the sarcode of the microscopic animal resembles in ultimate composition the flesh of higher creatures.

The hay infusion is sure to supply some animalcules, showing an advance of structure upon that of the Paramecium. A little oval creature, called Stylonichia, scarcely so long as the largest Paramecium, is common, and has, besides swimming cilia, some stiff bristles at each end, and with these it can walk briskly over any substance. There are many other animalcules similarly provided. The skin, or integument, in some cases acts like the crab's shell, or the insect's external skeleton of the horny substances called chitin.

Let us for a moment consider the indications of nerve power, without nerve structure, afforded by the creatures we have noticed. First comes the perpetual movers. The action of their surroundings upon their bodies causes the molecules that do rudimentary nerve work to respond to certain impressions by stimulating the cilia to their rapid motion. The creatures that can be quiet when in full vigour, and vary their movements with apparent purpose, prefigure the voluntary actions of higher beings. The little animals that can run, or swim, exercise something that prefigures choice as to which set of locomotive organs they employ. The reader may ask, Have they any sense of pleasure in their busy and merry-looking existence? To this very natural query it is difficult to give even a conjectural reply. Consciousness of existence could not be conceived of them, but a feeling of pleasure may long precede any kind of knowing, and we may gratify our own sympathies, and not be far wrong if we deem them happy in their little way.

NIGHTS WITH A THREE-INCH TELESCOPE.

BY "A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY."

PENDING the appearance in the eastern and south-eastern sky of the spring and summer constellations, we shall devote our present night to an examination of the more strictly circumpolar ones. Our original intention was to have gone over Virgo and the neighbouring region of the heavens. This, however, had, we now think, better be deferred until that constellation approaches nearer to the meridian during the working hours of the ordinary amateur observer. Moreover, more than one of the constellations we propose to investigate is now in a very favourable position. First, then, let us turn to, perhaps, the best known of them all—Ursa Major (Map, p. 384), now high in the north-east. We will begin by turning our telescope, armed with a power of 120, upon ζ (Mizar). Sharp-sighted people will detect with the naked eye a small star (Alcor) in the immediate neighbourhood of Mizar. In the telescope with the power specified, Mizar itself will be seen to be double, and forming with Alcor the pretty triple system shown in Fig. 23.

The pale-green of the small star of the pair will be noted. ξ Ursæ Majoris, examined with the very highest power at the disposal of the observer will furnish an absolutely crucial test of the excellence at once of his eye and telescope. 23 Ursæ Majoris is rather a wide pair, but interesting from the different tints of its components. 57 is a pretty pair for a similar reason, but very much closer than the last; it is unnumbered in the map. 65, a fine triple, is also unnumbered, but may be recognised to the south of χ on the boundary of Canes Venatici. γ Ursæ Majoris lies in a fine field of stars. This constellation, we may remark, swarms with double and triple stars, but as in a large proportion of cases they are of less than the 6th magnitude, the map takes no account of them, and it would be useless to give their co-ordinates, unless the observer's instrument were equatorially mounted. Several interesting nebulæ are to be found in Ursa Major, but in the case of the student for whom these papers are written, it can only be by fishing. If he will conceive an equilateral triangle, to be described with α and 23 Ursæ Majoris at the extremities of its base; then, by sweeping about to the right of its apex with the very lowest power he possesses, he may hit upon the two nebulæ 81 and 82 Messier, $\frac{1}{2}^\circ$ apart. About 2° (four diameters of the moon) south-east of β is another nebula, 97 Messier, a pale circular object, looking like the ghost of a planet. An imaginary line drawn diagonally from α through γ Ursæ, and continued nearly as far again, will strike upon ♅ V. 43, an oval nebula. Half-way, too, between β and 97 Messier lies ♅ V. 46. This will require some gazing at with so small an aperture.

Fig. 23. ζ Ursæ Majoris. Fig. 24. The Pole Star. Fig. 25. η Cassiopeiæ.

And now we will direct our telescope, armed with a power of 160, to the Pole Star, which will be seen as depicted in Fig. 24.

This is sometimes alleged to be a test for a 3-inch telescope, but it is not so. Dawes has seen the companion with a 1·3-inch object glass, and the eagle-eyed Ward, of Belfast, with only 1·25-inch aperture! North-west of ζ, Ursæ Minoris will be found π^1, a wide and easy object.

Cassiopeia is one of the constellations through which the Milky Way passes, and hence it affords innumerable rich fields and clusters to repay the observer who sweeps and fishes over it; γ, to begin with, lies in a fine field of small stars. η Cassiopeia, shown in Fig. 25, as viewed with a power of 160, is a beautiful object, the

colours being so well contrasted. Ψ is a triple star, but, with our optical means, will only be seen as a rather wide double. σ Cassiopeiæ, to the south of β, is a beautiful, delicate, and by no means easy, double star; a sort of miniature of ε Bootis, which we shall describe in a future "Night." About κ, between γ and κ, between π and ο, &c., lie some of the beautiful fields of stars to which reference has been made above.

Camelopardus contains several more or less striking pairs; but as none of them are marked in our map of reference, we pass on to Lynx, where we find 38 (Map, p. 298) a very close, delicate, and rather difficult pair. 19 Lyncis is a pretty triple, but it does not appear on the map. As both Cepheus and Draco are below the Pole, we must defer our description of the principal objects of interest they contain until some future occasion.

Errata.—In "Nights with a Three-inch Telescope," on p. 376, paragraph 2, line 4, "lower circle" should be hour circle; and at the beginning of paragraph 3, "Cancri" appears instead of Cancer.

NOTES ON ROWING.

By an Old Club Captain.

CONSIDER now in what respects the racing-boat of our time differs from the racing-boat of 1840. It is much lighter, it is much narrower and sharper, and has a perfectly smooth keel, so that it encounters a much smaller resistance, the leverage of the oar is greater, and the oar is longer. Taking the last point first, we see that the oarsman *must* pull the oar more sharply to give even the same velocity of propulsion as in the old boats, for the simple reason that he works at the end of a longer arm, while the increased length of the other part of the lever (the oar from blade to rowlock) only makes up for this increase in the length of the part which lies between the rowlock and the handle. It can readily be shown that, apart from the acquired motion of the boat, the driving distance for one full stroke of the oar would differ very little with the longer oars but increased leverage of our time from that obtained with the old style of oars, if the angle through which the oar is swept were the same as of yore. But to obtain this angular sweep the handle of the oar of our time must be carried through a distance, greater in just the same degree that the distance from handle to rowlock has been increased. The hands must, therefore, move more quickly to give the same rate of propulsion as to the older boats. But these boats will take and retain between the strokes a greater rate. Consequently the oar must be urged more sharply still, if it is to be effective in giving to them the greatest speed they can attain. The long, steady pull proper in the old racing-boats would give, no doubt, to these much lighter boats the same rate of speed that it gave to the heavier boats, and with much less effort to the oarsman. But the racing-boat would not then travel at the best pace that can be given to it.

I would call special attention here to the circumstance that it is not a mere matter of opinion, but of absolute certainty, that the same stroke which was good for the old-fashioned racing boat must be ineffective for the modern, outrigged, smooth-bottomed, light racing craft. It can even be shown that the actual stroke rowed by Selwyn and his contemporaries, would not do more than simply follow the motion of a racing craft at full speed, instead of adding to its velocity.

Let us run through a little calculation, the elements of which, be it noticed, are not open to doubt or question:—

The University boats go over the $4\frac{3}{8}$ miles course on a good tide in about 21 minutes. We shall not be far wrong in saying that a very good racing boat would cover 4 miles *on still water* in about 20 minutes, or would move at the rate of 1 mile in 5 minutes (note that whether a boat is travelling with or against the stream the rower works as if in still water, for the boat shares the motion of the stream). Certainly this speed is attained in spurts, and a still higher speed in sharp bursts over a short course. A mile in 5 minutes, means 352 yards per minute, or 5·87 yards (or 17·6 feet) per second. This speed is not absolutely constant even in the lightest and best of our racing boats; but as every one knows who has watched the progress of a bumping race when the pursuing boat has its nose very near to or overlapping the stern of the pursued, falls off perceptibly between the strokes. Still the falling-off is very much less than in the best boats of half-a-century ago. We may fairly take 19 feet per second as the maximum velocity attained just at the end of stroke, and 16 feet per second as the minimum velocity just before the beginning of the next stroke.

Now, 40 strokes to the minute is pretty nearly the maximum attained even in spurts, the tendency being (as I shall presently explain) to diminish rather than to increase the number of strokes per minute. At any rate, 40 strokes per minute is very quick rowing indeed. If, then, the boat travels 17·6 feet per minute, she covers about half as much again per stroke, or 26·5 feet. In other words, a boat travels very nearly nine yards at each stroke, in the case of an absolutely first-class and perfectly trained "eight" in a good craft, rowing at top speed.

Now, it requires, with an oar suited for an outrigged craft, a very good reach forward and a good pull home, to give the blade a sweep of six yards in the water; and, taking account of slip through the water and of the arc nature of the blade's motion, we may consider five yards an unusually good *effective* sweep. Now, with the old-fashioned stroke, the oar was in the water at least twice as long as in the air, during each complete stroke (from feather to feather). If, then, this stroke were rowed now, the oar would be two-thirds of the fortieth part of a minute in the water, during which time the boat, with the motion already considered (whether supposed to be communicated by previous effective strokes or by the rest of the crew rowing properly), would travel six yards; so that rowing the old-fashioned stroke in the old-fashioned way, an oarsman would not be driving the boat at all, but simply following with the blade of his oar the (relative) motion of the past-rushing water.

It is obvious, then, that the stroke which was so effective in 1840 will not do now. It is equally certain that the requisite rapidity of propulsion cannot be attained by rowing the same sort of stroke, but more to the minute; for experience shows that no crew can keep up so quick a stroke as would be required—rowing full length, be it noticed, for else the quickening would do no good. Nor can men take a much longer stroke (in the same time), even with the modern sliding seats. Leverage is lost with increase of length; and though up to a certain point this consideration must be overlooked, it tells very much when the question is of adding a foot or so of forward reach to the reach which had already brought the oar to an inclination of some 40 degrees to the mid position when the leverage is greatest. The sliding seats add something to the old length of stroke,

and doubtless with advantage, but we were considering their use in the above calculation. More could certainly not be added, without bringing the oar to a position in which a large part of the oarsman's strength would be wasted in pushing the water from the boat instead of parallel to the boat's length.

It is, then, a simple matter of demonstration that the stroke must be changed, in the modern racing craft, in respect of the time during which the oar is in the water. If a greater rapidity of propulsion is required, as we have proved, and neither the number of strokes per minute, nor the length of the stroke, can be increased beyond a certain point, which does not suffice to give the necessary rapidity of propulsion, it follows of necessity that the oar must be a shorter time in the water and a longer time out of the water.

This is commonly misunderstood, especially by persons who have never rowed in light racing craft. They say, the stroke must be kept "long in the water," and in one sense they are perfectly right: the stroke of the oar in the water must be as long as possible in distance, but *not in time*. But then "comes answer like an Absey book," You advocate a quick stroke, and more than so many—say from forty to forty-four strokes per minute—should not be taken. This again is true, the oar must be dashed through the water quickly (or rather, for in good rowing there is very little slip, must be dashed down sharply against the water and the boat lifted along by sharp strong pressure against the water), but not too often to the minute. But then, again, comes still the objection, That means a slow feather, for if each stroke from feather to feather occupies a certain time, shortening the stroke means lengthening the feather; and every moment that the oar is out of the water the boat is losing speed. Again we reply, the objection is valid; but it is a necessity of the case that to give the swift, sharp impulse to the long, but quickly drawn, stroke, the oarsman must take a longer time in the feather. Of course, the best thing of all would be to have as many strokes as possible per minute, the longest possible stroke, taken in the shortest possible time, with the longest possible oars, and in the lightest possible boats. But the rowers being limited in their powers, the choice must be made between long dragging strokes with lightning feather, and long but swift strokes with less rapid recovery; and as the long dragging strokes would simply not propel a boat at all at the swift pace of a modern racing craft, the long, swift stroke must be taken. (Here Pendragon, of the *Referee*, who sat heavily upon the Editor, three years ago, for asserting the necessity of these long, but swiftly taken strokes, may come in if he please, and say we advocate short, swift strokes, which every great race of the last ten years has shown to be ineffective.)

To sum up,—a modern racing eight, whatever may have been the tub practice of the crew, must be driven by sledge-hammer strokes, long and sweeping, but sharply taken, and resulting from the concentrated exertion of all the energies of the body, followed by a moderately quick recovery, during which the oarsman gathers himself together as it were for the next great effort, a momentary pause (which in old times would have been called a hang on the feather, and deservedly criticised as a defect) preceding the simultaneous plunge of the eight oars to grip the beginning of the stroke. In other words, a stroke must be taken which, with the old fashioned boats, even when they had attained their best speed, would have meant breaking the oars, if the men were only strong enough to give it. How this impulsive stroke is to be given we shall consider in our next.

THE CRYSTAL PALACE ELECTRICAL EXHIBITION.

SEVENTH NOTICE.

THE Lane-Fox (Fig. 3) differs somewhat from the two lamps described last week, the chief difference being in the connection between the filament and the wires from the generating machine. The glass bulb is about 3 in. long and $2\frac{1}{8}$ in. in diameter. The filament is made from bass-broom, and is connected to short pieces of platinum wire, which are fused into the glass tubes A, B. The lower ends of the wires are immersed in small quantities of

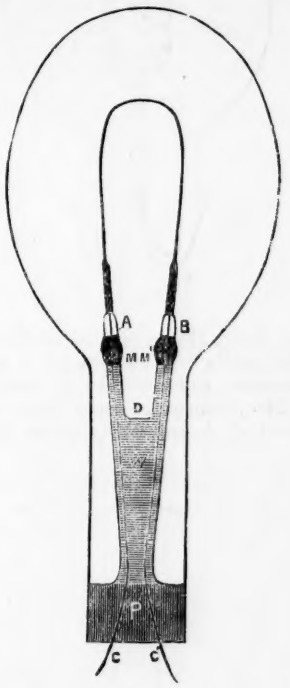


Fig. 3.

mercury, M, M'. Two copper wires, C, C', pass from the mercury through the lower portions of the tubes, A, B, (which merge into one tube at D), and thence outside the lamp. The wires are then soldered to the portions of the socket connected to the machine. The tubes, A, B, and their continuation, D, are filled with plaster of Paris, P, and wool, W, keeping the copper wires and mercury in position.

The Maxim lamp (Fig. 4) exhibits another form of contact or connection. The globe is about $2\frac{3}{4}$ inches in diameter, the neck, A, B, being turned inwards until the aperture at C, is reduced from about an inch to a quarter of an inch. A glass rod, CD, is then fused on at C, and has two platinum wires passing through it. Externally the wires are continued to E and F (outside the neck), so that in fitting the lamp into its socket, the wires come into contact with two insulated springs, each of which is connected to one of the machine wires. Inside the lamp, the platinum wires are flattened and bent into a kind of hook (H). The filament, which is flat and in the shape of a gridiron, or letter M (for Maxim), is made from paper, so that in cutting it out, there is little or no difficulty in making the extremities considerably broader than the other

portion. A small circular platinum washer is placed on one face of each end, the hooked end of the platinum wire on the other, and a small bolt (!) passes through the whole. Small nuts screwed on to the bolt clamp the three parts, and so ensure the connection.

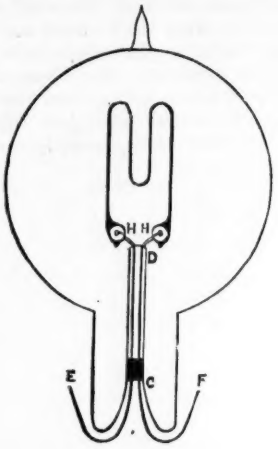


Fig. 4.

The British Lamp (Fig. 5) is perhaps the most recently offered to the public. It consists of a glass globe, $2\frac{1}{2}$ inches in diameter, continued by a comparatively long glass tube. The filament is made from cocoa-nut fibre, and is attached at A and B by means of small carbon

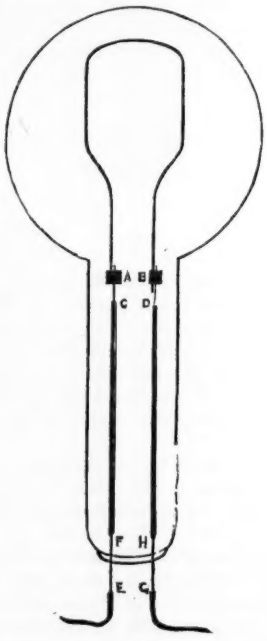


Fig. 5.

tubes to two short platinum wires, AC and BD. Two other platinum wires, EF and GH, are fused into the lower part of the glass tube, FC and GH being lengths of copper wire connecting the platinums. Externally, copper wires connect the platinum to the wires from the machine.

It will doubtless be noticed that the similarity between the various lamps is, at least in regard to the principles involved, very great. The slight variations or differences may be classed under two heads—viz. (1), the substances from which the filaments are made, and (2) the methods of connecting the filaments to the external circuit. Platinum, so far as is at present known, is the only substance available for passing *through* the glass, being the only metal which will fuze into that substance—that is to say, it is the only metal which expands and contracts at the same rate as glass on an increase or decrease of temperature. Its use is, therefore, inevitable. Swan, Edison, and Maxim take their platinums from the filament to the outside of the bulb. Lane-Fox, however, connects the interior to the exterior by means of mercury—a device which appears useless, for equally good contact could be made by attaching the copper to the platinum. The copper wires inside the British lamp are evidently used on the score of economy, platinum costing about 25s. to 30s. per ounce. Whether it is true economy or not, remains to be proved. We, however, fail to see why this form of lamp should be valued at 10s., while the Swan can be bought for 5s.

Great efforts have been made by the different exhibitors to secure the public favour, and in some cases these efforts have been successful; but there are times when we detect traces of a want either of ordinary energy or of practical knowledge, and it is to the absence of such shortcomings that we must look for an explanation of much of the favour with which Mr. Edison's exhibits are received. Although he has a large staff in London, most of them are Europeans, and are, therefore, not open to the charge some people seem disposed to hurl at them, as accounting for their diligence and enthusiastic loyalty to their employer, viz., that of being Americans. It would be somewhat invidious to draw any distinction, or to refer to any particular instance of inexperience, but we may mention one which came under our notice some years since. Shortly after the transfer of the telegraphs to the Government, a number of men were sent to construct a line of telegraph in a woody district not a thousand miles from London. They did their work during the winter months, and followed out to the letter instructions to keep the line as clear of the road as possible. They did their work *too well*, for when the spring and summer came, and covered the trees with shoots and leaves, the wires were enveloped and lost sight of, and as a consequence the slightest shower of rain rendered them useless. The result of this want of experience was that the line had to be taken down and reconstructed. Electric lighting, however, is a young industry, and some time must elapse before all its votaries acquire their necessary information.

There are other points of great interest in connection with incandescent lighting, which, however, we cannot refer to now, but will avail ourselves of the opportunity in our next notice.

THE GREAT PYRAMID.

By the Editor.

THUS far all has been tolerably plain sailing. Of the astronomical use and purpose (not quite the same thing, be it noticed) of the Great Gallery, there can be small room for doubt, when we find (1) every feature in all the passages and in the Great Gallery correspond with the requirements of the theory, and (2) many features explicable in no other way.

But here our difficulties begin. Astronomy no longer lends its aid when we ask why the builder of the Great Pyramid wanted to have an astronomical observatory as well as a tomb. To begin with, I suppose Egyptologists are quite clear that a main purpose of each pyramid was that it should serve for a tomb. And I suppose, further, that this being so, it was essential that each pyramid, including that one which we have been regarding hitherto only in its astronomical aspect, should be as nearly as possible completed before the death of its future occupant. There may be, for aught I know, some reason to believe that in the days of the pyramids an Egyptian king might be able in some way to assure himself of the *bona fides* of his successors, and that they would continue the work which he had begun and more than half completed. But it is very difficult to imagine that this really was the case. Human nature must in those days have resembled pretty closely human nature in our own time; and it seems as unlikely that a king could trust in his successors so far as to believe they would expend large sums of money and a great amount of labour, in completing a work in which they had no direct or actual interest, as that, supposing he trusted them to this degree, their conduct after his death would have justified his confidence. Thus, when we find that the Great Pyramid was actually completed in the most careful and perfect manner, we have very strong reason for believing it to have been all but completed during the lifetime of the king, its builder—if it was indeed intended for his tomb. I must confess that the exclusively tombic theory of the Great Pyramid (at least) had always seemed to me utterly incredible, even before I advanced what seems to me the only reasonable interpretation of its erection. One may admit that the singular taste of the Egyptian kings for monstrous tombs was carried to a preposterous extent, but not to an extent quite so preposterous as the exclusively tombic theory would require. Of course, when we see that the details of the great edifice indicate unmistakably an astronomical object, which was regarded as of such importance as to justify the extremest care, our opinion is strengthened that the pyramid was not solely meant for a tomb. For this would bring in another absurdity, scarcely less than that involved in the exclusively tombic theory of structures so vast, if even they were non-astronomical,—this, namely, that the Egyptian kings thought the celestial bodies and their movements so especially related to *them*, that their long home must be astronomically posited with a degree of care far surpassing that which has *ever** been given to an astronomical observatory. Common sense compels us to believe that whether the Great Pyramid was meant for a tomb or not, its astronomical character was given to it for some purpose relating to the living king who had it built. (I suppose Egyptologists are absolutely certain that the Great Pyramid *was* built by one king, and, therefore, within a few decades of years.)

Now, it is not reasonable to suppose King Cheops' purpose was simply scientific. We may fairly take it for granted that the king who expended such vast sums and sacrificed so many lives to build for himself a tomb, was not a man taking a disinterested interest in science, or even ready to help the priests of his day to regulate religious ceremonials by astronomical observations conducted with reference only to general religious relations. To put the matter plainly, the builder of the Great Pyramid must have thought of himself first; next, of his dynasty; then, perhaps, of the priesthood (though always with reference to the bearing of religious ceremonies on the welfare of himself and his dynasty); lastly, of his people, as part of his wealth and power. For abstract science he cared not, we may be well assured, a single jot. I do not wish to suggest that Cheops was wickedly selfish. I have no doubt he was thoroughly persuaded that he was carrying out the purpose of his existence in expending much treasure and many lives on his own well-being (both before and after death). But there can be no doubt this *was* the real object of his expenditure of time, and wealth, and human life on the great structure which bears his name.

Now, our thoughts are at once turned by these considerations to that one sole line along which astronomy ever has been followed with the hope of material profit; and we are led to remember that if there is one idea which has more strongly taken possession of the human race than any other, or one which more than any other is associated with the astronomy of ancient Egypt, it is the idea that the stars in their courses rule the fate of men and nations. When we remember that even now, when science has shown the utter incorrectness of the ideas that underlie the ancient system of astrology, this system has its influence over millions. Even now the terms belonging to the system remain part of our language. Our very religion has all its times and seasons regulated in ways derived from the astrological system of old Egypt. Our Sunday is the old Chaldæan and Egyptian quarter-month rest day, and the Jewish Sabbath is this quarter-month rest day associated with the belief in the malefic influence of the planet (Saturn), which formerly ruled the last day of the week (still called Saturday or Saturn's-day). The morning and evening sacrifices of the Jews and their new moon festivals were manifestly astronomical in origin—in other words astrological (for astronomy was nothing except as astrology to the old Chaldæans and Egyptians). The Feast of the Passover, however later associated with other events, was derived from the old astrological observance of the passage of the sun (the Passing over of the Sun-God) across the equator, ascendingly; while the Feast of Tabernacles was in like manner ruled by the passage of the sun over the equator descendingly. Our calendar rules for Easter and other festivals would never, we may be well assured, have been made to depend on the moon, but for their original derivation from astronomical (that is astrological) ceremonial.*

When we remember that the astronomy of the time of Cheops was essentially astrology, and astrology a most important part of religion, we begin to see how the erection of the mighty mass of masonry for astronomical purposes may be explained,—or, rather, we see how, being certainly astronomical, it *must* be explained. Inasmuch as it is an astronomical building, erected in a time when astronomy was astrology, it was erected for astrological purposes. It was in this sense a sort of temple, erected, indeed, for the peculiar benefit of one man or of a single dynasty; but as he was a king in a time when being a king meant a great deal, what benefited him he doubtless regarded as a benefit also to his people: in whatever sense

* Even in our own time, though we get greater accuracy in our observations than Cheops obtained in his pyramid, we have not to give anything like the same degree of care to the work.

* The Jewish people, when they left Egypt after their long sojourn there, had doubtless become thoroughly accustomed to the religious observances of the Egyptians (at any rate there is not the slightest reference even to the Sabbath before the sojourn in Egypt), and were disposed not only to retain these observances, but to associate with them the Egyptian superstitions. We know this, in fact, from the Bible record. Moses could not—no man ever could—turn a nation from observances once become part of their very life, but he could, and did, deprive them of their superstitious character.

XUM

the Great Pyramid had a religious significance with regard to him, it had also a national religious significance.

It would have been worth Cheops' while to have this great astrological observatory erected, even if by means of it he could learn only what was to happen, the times and seasons which were likely to be fortunate or unfortunate for him or his race, and so forth. But in his day, as in ours, astrology claimed not only to read but also to rule the stars. Astrologers did not pretend that they could actually regulate the movements of the heavenly bodies, but they claimed that by careful observation and study they could show how the best advantage could be taken of the good dispositions of the stars, and their malefic influences best avoided. They not only claimed this, but doubtless many of them believed it; and it is quite certain that those who were not astronomers (*i.e.*, astrologers) were fully persuaded of the truth of the system which, even when the discovery of the true nature of the planets has entirely disproved it, retains still its hold upon the minds of the multitude.

There is, so far as I can see, no other theory of the Great Pyramid which even comes near to giving a common-sense interpretation of the combined astronomical and sepulchral character of this wonderful structure. If it is certain on the one hand that the building was built astronomically, and was meant for astronomical observation, it is equally certain that it was meant for a tomb, that it was closed in very soon after the king died for whom it was built, that, in fine, its astronomical value related to himself alone. As an astrological edifice, a gigantic horoscope for him and for him only, we can understand its purport, much though we may marvel at the vast expenditure of care, labour, and treasure at which it was erected. Granted full faith in astrology (and we know there was such faith), it was worth while to build even such a structure as the Great Pyramid; just as, granted the ideas of Egyptians about burial, we can understand the erection of so mighty a mass, and all save its special astronomical character. Of no other theory, I venture to say, than that which combines these two strange but most marked characteristics of the Egyptian mind, can this be said.

THE "SATURDAY REVIEW'S" COMET.

Cassio.—Why, *this* is a more exquisite song than the other.

THE effect of [Mr. Proctor's] note of alarm was promptly seen in the queer homily in the *Spectator*, of which we have already taken notice, having for its text this prophecy of Mr. Proctor, as one "of whose astronomical authority and ability nobody doubts." Upon this undoubted fact were founded some characteristic speculations as to the moral attitude with which the inevitable doom is likely to be met as the day draws near, which day Mr. Proctor would doubtless be able to fix with still greater precision. The Menacing Comet has, it appears, since been "scratched" in the pages of Knowledge. But the title of the essay, and what is drawn out as the line of proof, epitomised by us [query, *as* epitomised by the *Saturday Review*—Ed.] shows to our mind an unmistakable desire, however it may be sought now to turn it off as a playful freak of science, to make the reader's flesh creep. *How far*, indeed, so many of us as are not dead with fright *may have indications vouchsafed them of the coming catastrophe does not yet appear.* Nor does it very much matter. All must soon be over. "Mr. Proctor's name will have one instant of lurid fame, in which that and everything else connected with our corporeal life will expire." In a few weeks—possibly in a few days, or even hours, in the words of Mr. Proctor—the sun, excited for a while to intense heat and splendour, will resume his usual temperature, his usual lustre; but there will be no one to bask in his genial beams, no popular science teacher to tell of all he has done or is henceforth to do. [And no *Saturday Review* to give treatises on science for review to "society writers," reduced to the abject necessity of "stealing their thunder" from the authors they criticise.—Ed.] It may yet be that some spirits of a bolder and more hopeful turn, less trustful of popular science prophets, may bethink them that out of the myriads, not to say millions, of these menacing bodies that are said to circulate round the sun with the same chance of precipitation into his mass, *it would be odd if in the whole range of historical, or, let us say, geological time, such a catastrophe had never taken place before.* Yet, whether any such dreaded crash has come off or not, here at least we are. There has been, indeed, a strong impression that *the unwonted disturbance of the sun's surface, noted at once by Mr. Carrington and Mr. Hodgson, on Sept.* 1, 1859, *was due to the inrush of a comet* ["two meteors" it should be.—Ed.] *into the sun*; yet nothing came of it beyond a slight extra tremor of the galvanometer needles at Kew and elsewhere. Comparing the stupendous mass of the sun with the utmost material volume that can be assigned *to these filmy volatile portents of the sky, what great accession can we suppose any one among them to be singly capable of bringing to the vast cosmical centre of light and heat?* Any particularly nervous person may as well fling a pinch of snuff into the fire, and see how it affects a thermometer upon the opposite wall. After all our advance in scientific observation and theory for the last fifty years, are we really nearer to any definite knowledge of the material constituents or the physical conditions of these mysterious wanderers of our system? "What are comets made of?" asked a French lady of the most distinguished savant of the time. "Madame, I do not know." "Then what is the use of being an Academician?" "Madame, that I may be able to say I do not know." *It would never do for an oracle of popular science to have it thought there was anything he did not know.—Saturday Review* for March 18, 1882.

[The reader may find it interesting to compare the following five extracts, respectively, with the five italicised passages above.—Ed.]

Supposing there really is a possibility that our sun may one day, through the arrival of some very large comet travelling directly towards him, share the fate of the suns whose outbursts I have described above, *we might be destroyed unawares, or we might be aware for several weeks of the approach of the destroying comet.*—From "Myths and Marvels of Astronomy," 1877, by the Editor.

If among the comets travelling in regular attendance upon the sun there be one whose orbit intersects the sun's globe, then that comet must several times ere this have struck the sun, raising him temporarily to a destructive heat. Such a comet must have a period of enormous length, for *the races of animals now existing upon the earth must all have been formed since that comet's last visit*, on the assumption, be it remembered, that the fall of a large comet upon the sun—or, rather, the direct passage of the sun through the meteoric nucleus of a large comet—would excite the sun to destructive heat. We may fairly believe that all comets of the destructive sort have been eliminated.—From "Myths and Marvels," 1877, by the Editor.

I am not sure but that *we may regard the meteors which seem to have fallen on the sun on Sept.* 1, 1859, *as bodies travelling in the track of the comet of* 1843, just as the November meteors, seen in 1867-8-9, &c., until 1872, were bodies certainly following in the track of the telescopic comet of 1866.—From "Myths and Marvels," 1877.

The dread of the possible evils which might accrue if the earth encountered a comet will possibly be diminished by the consideration of the *extreme tenuity of these objects.*—The Editor, in Knowledge for *November* 11, 1881.

To the astronomer, the appearance of so many comets—some of them large ones—has been full of interest, because he hopes by the application of the new methods of research discovered within the last quarter of a century to solve some of the *mysteries with which the whole subject is still fraught*, despite a number of interesting discoveries which have recently been made.—The Editor, in Knowledge for *November* 4, 1881.

TRICYCLES IN 1882.

By John Browning.

SEVERAL correspondents have requested me to give my reasons for preferring the machines I have named as in the foremost rank in the previous article, and as I cannot reply to them individually, I will endeavour briefly to furnish such information here.

First, then, as regards the Rucker Tricycle. This is the only open-fronted, rear-steering machine in which the pedals are so placed that if the rider stands on them he adds to the stability of the machine by keeping the hind steering-wheel more firmly on the ground, while the pedals, being well under the rider, give the rider more power, particularly in hill-riding, with less fatigue. Another

great advantage the machine possesses is that it can be steered by either or both hands, and having a chain to each wheel, it is a *true double-driver*. In most of the open-fronted, rear-steering machines there is a tendency, when travelling down-hill, from the weight of the rider being in front, for the hind wheel to leave the ground. When this is the case, the power of steering is lost just when it is most wanted.

The Monarch I have selected for its originality, good workmanship, portability, and lightness. These good qualities are obtained by dispensing with all levers, chains, cog-wheels, or other gearing. The pedals are in the form of a stirrup, and are hung on the cranks.

There are no more bearings in the Monarch than there are in a bicycle, and all bearings are ball bearings. The brake acts on both wheels, and it is a true double-driver. It would be better if the brake acted on the hubs of the wheels, or on drums, instead of on the tires, and some persons would prefer the machine if the wheels could be made larger than forty inches, but small wheels are stronger, safer, and lighter than large ones, and a machine with small wheels can be driven much easier than one with large ones against that bugbear of tricyclists, a strong head wind.

The National Tricycle I mentioned for its lightness and excellent workmanship, but the lightness seems to have been exaggerated, for a machine which was supposed to weigh 65 lbs. proves to weigh 80 lbs.

The Improved Omnicycle solves in the best manner yet contrived the application of speed-changing gear to a tricycle. It gives the rider a command of three different speeds, which can be changed without stopping the machine. The gearing is strong, and is not likely to get out of order. It seems to me probable that the power of applying changeable gearing to a tricycle, so as to adapt it to the varying inclinations of the road or their condition, will, when the machine has been perfected, cause it to be generally preferred for road-riding, or at least for touring, to the bicycle.

In my former paper I have described the Humber tricycle, and spoken of it as the fastest machine yet made. I have, therefore, been asked if I strongly recommend this machine. I reply that I do for speed, but I think this has been gained at a sacrifice of comfort, and, to a certain extent, of safety. The Humber has no foot rests, and this greatly detracts from the comfort and safety of the rider when running downhill.

The new Rotary Coventry has the chain in the centre. It is one of the lightest machines made. The throw of the cranks can be altered at pleasure. It makes only two tracks, is an open-fronted machine, has ball-bearings to all parts, and is the most perfect of all machines in steering. This is due to the fact that it is steered by means of two wheels, which are moved by one rod in opposite directions.

The machine can be turned round in a circle one foot less than its own length. None of our fastest riders have ridden the Coventry Rotary in races. If they would do so, I think the machine would prove among the fastest machines made, probably coming very close to, and possibly equalling the Humber. The Coventry Rotary is an excellent luggage carrier, one of the most important advantages that can be possessed by a tricycle.

Scarcely a day passes without my being asked: "Which is the best tricycle?" It would be about as easy to answer another question. "What is the best thing to have for dinner?" So much in this case would depend upon the eater, and in the first case on the rider. Still a few hints may guide intending riders in the choice of a machine.

For a man about 9 stone I would recommend a special Salvo, with 46-in. driving-wheels, geared down to 40, if the country is hilly; or, perhaps better still, a Monarch, with 36-in. driving-wheels. A rider who wishes to obtain speed apart from other considerations, should select from the Humber, the Premier, or the Rucker, the last being probably the best of the three, because it is a true double-driver, and has a double break. For hill riding the Humber, the geared-down Devon, the improved Omnicycle, or the Rucker are all good. For a very heavy man the Salvo, with 48-in. wheels and 1-in. tires, is excellent, and so would be many other machines, if the makers were asked to make them equally strong for a specially heavy rider.

THE DUCHESS OF CONNAUGHT'S ILLNESS.

THE *Lancet* publishes the result of an inquiry into the sanitary condition of the Duke of Connaught's house at Bagshot-park. Dr. W. S. Playfair states that he writes this notice at the suggestion of the Duke of Connaught, as a matter of general interest to the medical profession, and in the hope that this instance of the danger which may arise from faulty construction and workmanship in the system of drainage may direct attention to the paramount importance of questions of this kind. These defects are believed to have led directly to the Duchess of Connaught's late serious illness, from which she is now happily entirely convalescent. It appears that the present house at Bagshot-park is not that long occupied by the late Sir James Clark, but an entirely new building, recently erected at a cost of from £30,000 to £40,000. Considerable pains were taken in the arrangement and ventilation of the drains, but not only was the system adopted in itself defective; the work was in many instances so carelessly carried out that it is surprising that in this new and costly mansion graver results did not follow. As a matter of fact, offensive smells had long been perceived about the house, but no one suspected their origin, or realised the danger they were likely to cause. Many of the inmates, however, had suffered from various forms of indisposition, such as sore throat, diarrhœa, and a general sense of heaviness and *malaise*, and these generally affected new-comers. About a fortnight after the accouchement of her Royal Highness the Duchess of Connaught, symptoms ominous of blood-poisoning presented themselves. Happily these were promptly recognised by Dr. Playfair, who has bestowed especial attention on the treatment of the puerperal state, and the only efficient means of cure was adopted, namely, instant removal. It is, however, with the cause of the perilous occurrence of incipient blood-poisoning that Dr. Playfair's statement is chiefly concerned. It may at first sight seem incredible, but it is the fact that the elaborately constructed system of baths, drains, and waste-pipes communicated directly with the soil drains of the building, and by a Machiavellian policy, which would appear to be the pastime of modern builders, pipes which ought to have been stopped were left open, and the poisonous gas which rises from fœcal accumulations was actually conducted, in sundry ingenious and wonderful ways, into the very apartments it was particularly desired to preserve from possible infection. The professedly "sanitary" constructors are, if possible, the least to be trusted. It would seem to be the common practice of these remarkable persons to ventilate the house-drains, and therefore, of course, the sewers generally, into bedrooms. We are repeatedly hearing of this piece of wantonness. Probably, in six cases out of ten the waste-pipes of baths and cisterns, which are never cleared by a current of water, except at the rare moment when a bath or cistern "runs over," communicate directly with a soil-pipe. It is well that the opportunity offered by this important instance of a wide-spread peril has been so ably utilised. The state of affairs at Bagshot, which Dr. Playfair has been not merely permitted, but commissioned, to disclose, may be taken as typical of that which prevails probably throughout the class of modern and what are misleadingly called sanitary houses. Dr. Playfair says he has long been satisfied that sanitary defects have often much to do with grave forms of illness after child-birth, the origin of which illness cannot otherwise be traced. He mentions two or three cases in which exposure to sewer-gas, as he believes, caused puerperal disease; they were cured by removal. Fortunately, in the case of the Duchess of Connaught, her symptoms did not commence for more than a fortnight after her confinement; and her removal, too, was immediately followed by a most remarkable and instructive change for the better.

VIVISECTION.—It is the notion of such absolute despotism as shall justify, not merely taking life, but converting the entire existence of the animal into a misfortune, which we denounce as a brutal misconception of the relations between the higher and the lower creatures, and an utter anachronism in the present stage of human moral feeling. A hundred years ago, had physiologists frankly avowed that they recognised no claims on the part of the brutes which should stop them from torturing them, they would have been only on the level of their contemporaries. But to-day they are behind the age; ay, sixty years behind the legislature and the poor Irish gentleman who "ruled the houseless wilds of Connemara," and had the glory of giving his name to Martin's Act. How their claim for a "free vivisecting table" may be looked back upon a century to come we may perhaps foretell with no great chance of error. In his last book, published ten years ago, Sir Arthur Helps wrote these memorable words: "It appears to me that the advancement of the world is to be measured by the increase of humanity and the decrease of cruelty. . . . . I am convinced that if an historian were to sum the gains and losses of the world at the close of each recorded century, there might be much which was retrograde in other aspects of human life and conduct, but nothing could show a backward course in humanity" (pp. 195, 196). As I have said ere now, the battle of Mercy, like that of Freedom,

once begun,
Though often lost, is always won.

—Miss F. P. Cobbe, in the *Cornhill Magazine*.

LOOPED PATH OF A PLANET.

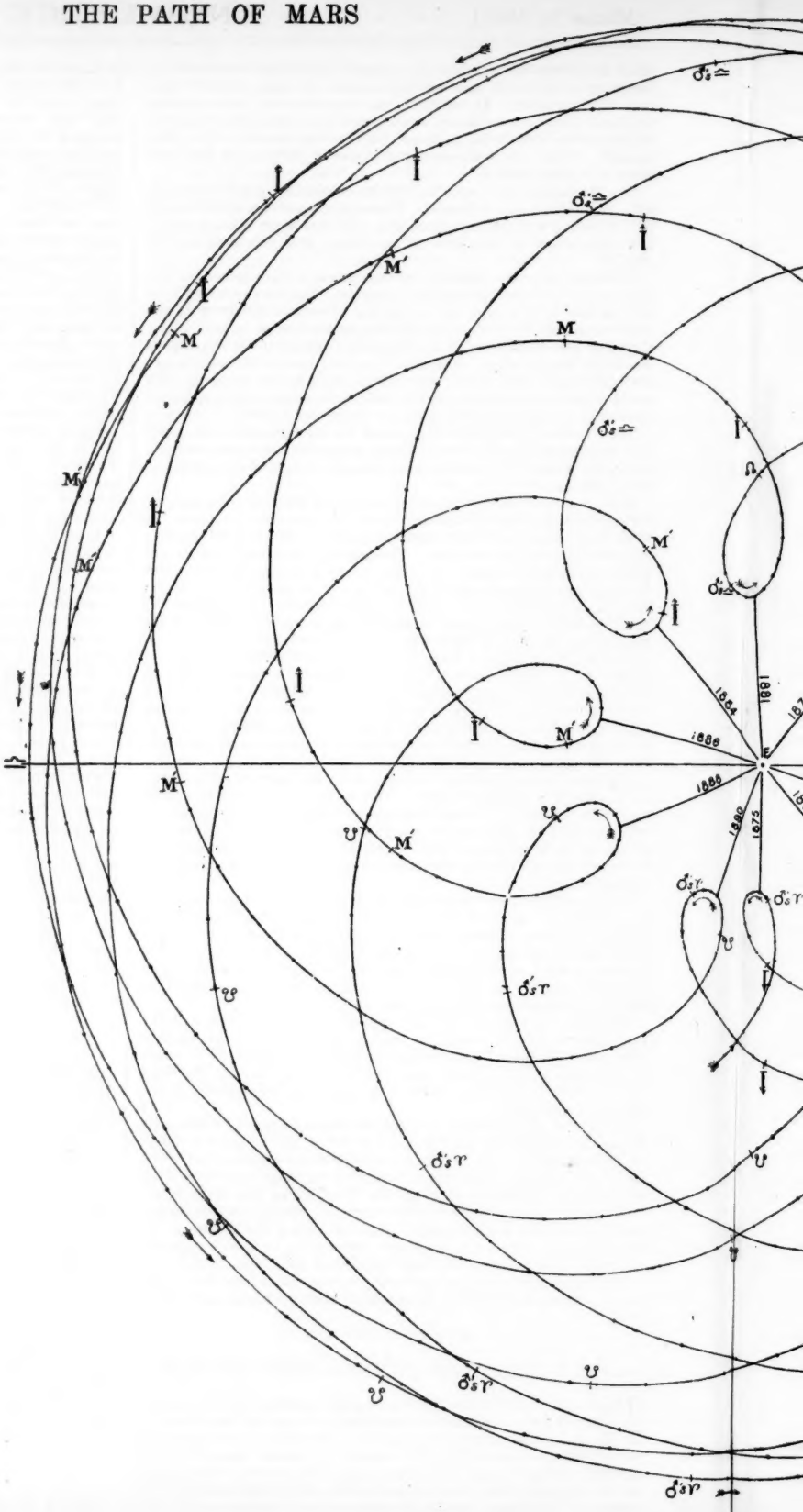
By the Editor.

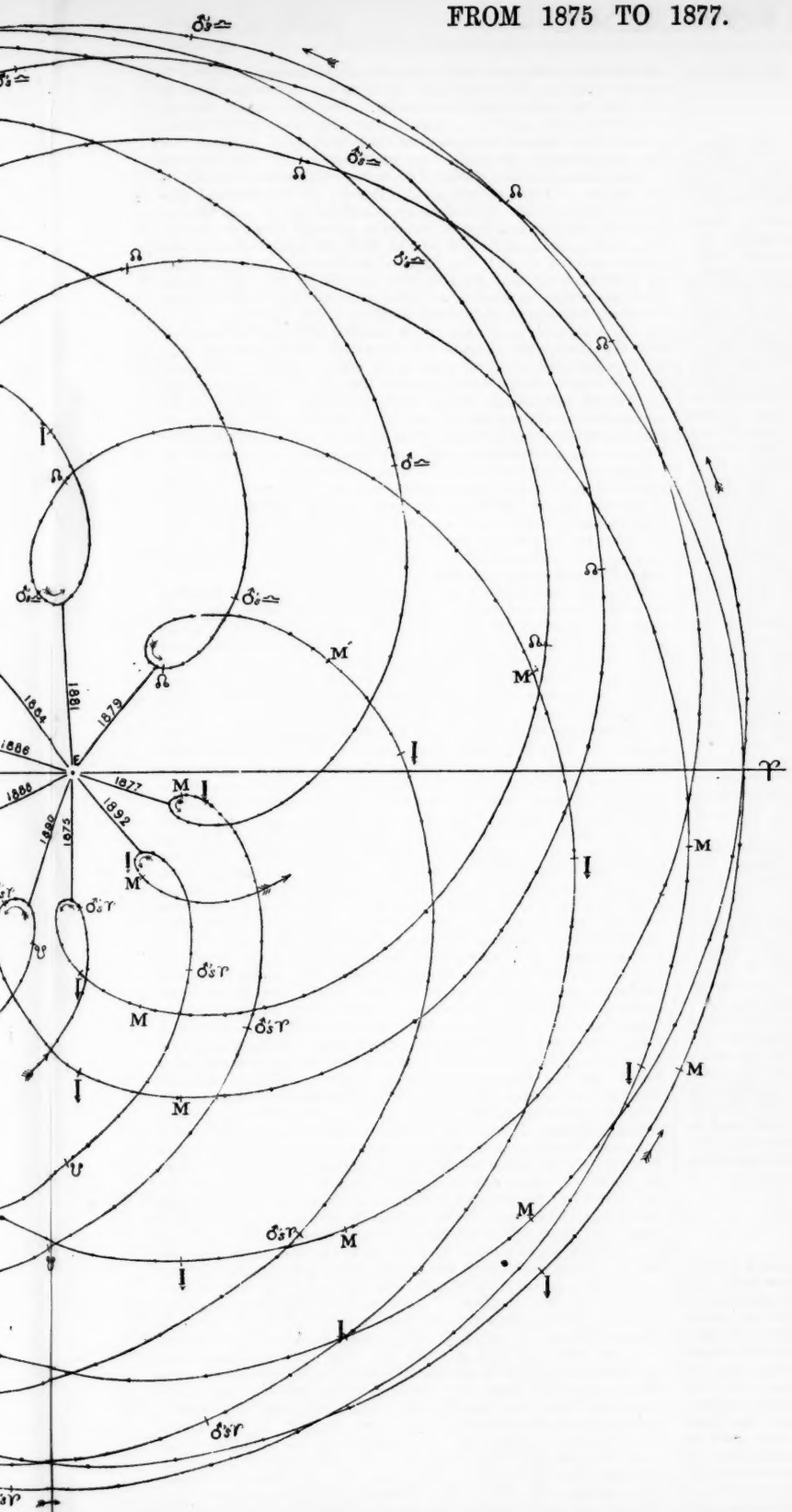
MANY even of those who have read the usual descriptions of planetary motions, in our text-books of astronomy, are perplexed by the way in which the planets pursue

Their wandering course, now high, now low, then hid,
Progressive, retrograde, and standing still.

Mars, Jupiter, and Saturn, during the last few months have given striking illustrations in the skies (as indicated in our maps) of their strange, and at first view, fantastic and irregular motions. Mars, in particular, traverses a singularly devious course upon the background of the starlit heavens. It has seemed to me that it would be interesting to exhibit the real course of this planet, the one of all the sun's family whose path, with reference to the earth, has the most complicated form. Of course, in reality this planet travels around the sun in an ellipse which is almost circular in form, though considerably eccentric in position. The earth also pursues an elliptic path, smaller in size, still more nearly circular in form, and much less eccentric. But viewed from the earth, the planet Mars, in consequence of the combination of these two circling (but not strictly circular motions), travels on such a looped path as is shown in the accompanying map. Here the planet's position, as viewed from the earth (his geocentric position, as it is called), at the successive oppositions (or times of nearest approach to the earth), is shown by the small dot at the end of the dated radial line. Then, at successive intervals of ten days, measured forward and backward from the time of opposition, Mars has the positions indicated by the successive dots. (Of course, there is a place in the outermost

THE PATH OF MARS





part of each whorl where these ten-day dots meet without an exact ten-day interval; this, however, is unimportant, as in these parts of his geocentric path Mars is invisible. At the proper places along the planet's looped geocentric path are shown the places where Mars is in perihelion (M), aphelion M′, at a rising node (or crossing the plane of the earth's orbit from north to south), (☊), at a descending node (or crossing the plane of the earth's path from south to north), (☋), the place where he attains his greatest distance north ($\overset{\wedge}{\mathrm{I}}$) and south ($\underset{\vee}{\mathrm{I}}$) of the plane of his orbit; the place where Mars is at the point of his orbit corresponding to the vernal equinox (beginning of spring) of his northern hemisphere, marked ♂'s ♈, and the corresponding point for the autumn of Mars, marked ♂'s ♎.

The scale of the drawing is the same as that of my picture of the orbits of the terrestrial family of planets (Mars, Earth, Venus, and Mercury), in the "Encyclopædia Britannica," viz., fifty million miles to the inch, and on this scale the lines I, I, &c., indicate the greatest distance attained by Mars north and south of the plane of the ecliptic. The northerly displacement, it will be seen, is the greater.

The path of Mars must be regarded as passing above the plane of the paper, at a point marked ☊, gradually attaining its greatest height (indicated by the length of the "I") above that plane at the point marked $\overset{\wedge}{\mathrm{I}}$; gradually returning towards the plane of the paper, which it crosses again at a point marked ☋; then attaining its greatest distance below the plane of the paper at the next point marked $\underset{\vee}{\mathrm{I}}$; whence it returns gradually to the plane of the paper at a point marked ☊; and so on continually.

XUM

CHALCEDONY CONTAINING LIQUID WITH A MOVABLE BUBBLE.

By the Rev. Henry H. Higgins.

TWO specimens were brought from Monte Video by Mr. Philip Rathbone. The larger piece contains not less than an ounce of liquid, with a large bubble—the smaller seems to have more liquid in proportion. A third specimen is broken, showing the walls of the chamber to be, in the thinnest part, not more than $\frac{1}{10}$ of an inch in thickness. The mineral seems to have been recently discovered, no mention of it being made in Dana's text-book, 1880. F. W. Rudler, Professor of Mineralogy in the Royal School of Mines, informs me that he has not seen any published description of Chalcedony enclosing water with a movable bubble. I am not a mineralogist, and make the following conjectures with much diffidence. In some cavity deep in the earth, and probably under great pressure, occurred a hollow containing a small quantity of water, above the boiling point, but kept liquid by pressure, and supersaturated with silica. On any diminution of the temperature, which might occur extremely slowly, the fall of one degree occupying perhaps long ages, crystallisation would set in on all the sides of the hollow holding the liquid, and at the same time would be formed on the surface of the water, a crystalline pellicle, from which crystals would shoot downwards and inwards. Thus would be formed a cavity enclosed on all sides and filled with liquid. Layers of opalised quartz, chalcedony, might now be deposited externally upon the roots of the crystals, forming a cell with walls impervious to water or gas. Further diminution of temperature would enable minute quantities of gas contained in the water to assume a gaseous form and unite in a bubble. In the broken specimen, the walls distinctly show the radial disposition of the crystals forming the lining, and the stalagmitic character of the outer rind in which the chalcedony is deposited in layers like the laminæ of an onyx or an agate. In the large specimen, the outer surface is very interesting. It is covered with low tubercles arranged in circles $\frac{1}{4}$ in. in diameter, each circle having within it several similar concentric circles. The cavity is not strong enough to withstand any considerable bursting pressure from within. It is possible, however, that the shrinkage of the contents of the cavity from cold may have maintained the equilibrium between outside and inside pressures. Although the tank-forming chalcedonies do not appear to have been described, quartz crystals with minute drops of movable bubbles enclosed have long been common in all collections of minerals.

John W. Judd, F.R.S., in his admirable work on volcanoes, gives the best, almost the only description I have seen of them. The liquid may be water, a hydrocarbon, or even carbon dioxide. That it may be the *last* has been proved by spectrum analysis, and by the test that when the crystal is heated to 86° or 90° Fahrenheit, the bubble disappears; that temperature being for carbonic dioxide, the critical point above which no pressure can keep it in a state of liquidity. Still more remarkable is Mr. Judd's account of microscopic cavities containing liquid in which the bubble is in constant motion, pursuing a spiral track from end to end of the cavity. For the only attempt at explanation of this motion yet given, Mr. Judd's work may be consulted, and no one will regret having read the book from the first to the last page. All the cavities of which Mr. Judd speaks are very minute, and it is evident that the tank-forming chalcedonies are constructed in some manner to which the quartz crystals containing drops can afford no sufficient clue, though as in my own case, Mr. Judd's beautiful researches may lead to more or less reasonable guesses. Through the kindness of Mr. Rathbone, the smaller specimen and the equally interesting broken one have been placed in the Liverpool museum.

MODERN DRESS.

ECCENTRICITIES of costume have in all ages formed a prominent subject on which satirists have expended the magazine of their wit; and in the present day no inconsiderable attention is given to it by those who make it a business to caricature the follies of their fellow beings. It is, however, an all but recent development that is being witnessed now in connection with the efforts made by the medical profession to awaken the public to a sense of the self-inflicted evils suffered from absurd compliance with the demands of "fashion." Nor can we feel anything but sincere satisfaction that this question has so far become a "burning" one; and that men of the highest eminence deem it part of their duty to society to issue warnings against the miserable consequences of sacrifices offered to the shrine of appearance. The physical evils of inappropriate dress are so manifest to the physiologist, the constitutional damage they entail so apparent to the physician, the miseries they create so evident to the social economist, that it is rather a matter of wonder they have so long been permitted to continue unchecked and unreformed. Now and again, indeed, individuals in the past have raised a warning voice against indulgence in the fashionable caprices of their time; but never before has a determined attempt to improve public taste and educate public ignorance in the matter of dress been made that characterises the action of the National Health Society in this respect. Recently, however, Mr. Frederick Treves, F.R.C.S., of the London Hospital, delivered a lecture before a crowded audience in the Kensington Hall, on behalf of the National Health Society, the subject selected being, "The Dress of the Period." It is gratifying to hear that unusual interest was excited by the preliminary announcements; we shall perhaps be indulging in unlicensed hopes, however, if we permit this result to create in our minds a belief to the effect that the public are at last growing alive to the harmfulness of following the dictates of fashion with the unreasoning submission exhibited in the adoption of its most outrageous demands. It is true the audience which greeted Mr. Treves's demonstrations of modern fashionable follies with applause, indicative of its approval of his denunciations, was chiefly made up of ladies whose claim to be regarded more or less as victims to the Moloch under censure was indisputable; but notwithstanding, it would be the refinement of rashness to expect from them an immediate renunciation of tight waists, cramped feet, and swathed limbs. The hold of these on the lives of those who form "society" is too secure and too steadfastly maintained to permit its being easily removed. We can trust for this happy result to nothing but a general and an intelligent apprehension of the mischief attendant on continuance of the evils which carry such disasters in their train.

The ill-consequences set up by improper dress are most familiar to medical men; and medical men necessarily, therefore, are those most competent to advocate reform in customs to the injurious effects of which they are daily witnesses. In the particular folly of tight lacing, for instance, there is probably no practitioner who is not constantly called on to remedy the evils it produces. In young girls, who, least of all, are calculated to support the strain to which their internal organs are submitted under the cruel pressure of the corset, we have often to deal with piteous examples of the sacrifices required in order to ensure a small waist. Nor is it that they suffer only while young. During their whole after-life, symptoms referable to visceral displacement and disorganisation are of frequent occurrence; no woman, probably, who has at any time conformed to this fashion of abdomen-strapping being free from some form of gastric or liver trouble. To what extent, moreover, the craze for "an elegant figure" may carry its victim is scarcely credible, except for occasional proofs afforded at inquests and post-mortem examinations. While it is not unusual to find the liver deeply indented by pressure of the adjacent ribs and displaced deep into the pelvis, it has more than once been found that long-continued constriction of the body has resulted in hour-glass deformity of the stomach. Nor need we long hesitate to decide on the influence this vicious form of fashionable sacrifice exerts on the duration of female life, when we reflect on the prevalence among the middle and upper classes of the very diseases which would be induced by persistence in such habits. Gastric ulcer is at least three times as frequent in women as it is in men. Syncope is a common form of weakness exhibited by young women who subject their viscera to the vice-like compression of a corset; and the intestinal troubles set up by interference with the functions of the liver, together with the distributed pressure on the intestines themselves, are among the most productive sources of feminine illness. Indeed, the subject of tight lacing might with advantage be taken as the sole topic for a considerable number of lectures; and the more tellingly the evils it ensures are put before the public, the more convincingly they can be taught to perceive the fatal injury the practice is doing to the race, the more speedily and surely will it cease to be commonly indulged in. We would urge this point—that of the injury suffered through it by the whole race—with especial force. By as much as any woman undermines her own health—it matters not in what manner the mischief is done—to such an extent is she also injuring the physique that will be inherited by her children. Perhaps, by exciting the maternal instinct, more benefit will be derived than by any other means at present devised. At any rate, the proposal deserves consideration.

Apart from tight lacing, there are other evils associated with modern clothing that deserve equal attention. Space forbids more than a mention of them now, but we may instance the inadequacy of modern dress to secure either of the two important desiderata—appropriate protection and equable temperature. As Mr. Treves pointed out to his audience, a fashionably-dressed woman of to-day is all but nude about the chest and back, at most but a thin, single or double layer of material protecting these delicate and susceptible regions, while a huge mass of useless clothing is swathed about the hips and legs, and trails in abundant prodigality to clothe the

floor around. Again, the disastrous senselessness of "Parisian" shoes, high-heeled and taper-toed, needs no enforcing; but the fashion which insists on them will need a very strenuous and determined opposition ere it is finally conquered.

We are glad to be able to offer Mr. Treves our hearty congratulations, both on the admirable lecture he delivered, and on the unmistakable success with which it has been attended.—*Medical Press and Circular.*

COMPOUND PENDULUM.

A QUESTION was asked lately in KNOWLEDGE about the curves drawn by the Compound Pendulum. I have made for myself one of these instruments, by which were drawn the curves which I enclose. The machine was made as follows:—

I procured two hollow brass rods about 3 ft. long. At 6 in. from the top of each a steel pin 2 in. long is driven through, and filed on the under side to a knife edge, to form the fulcrum for the pendulum. A plug of ivory is fixed in the top of each rod, having a small conical cavity drilled in it. On each rod are two cylindrical leaden weights, which slide upon it, and can be fixed at any height by a collar and screw. Each weight is divided, because it is better sometimes to use half the weight on eah rod. (See Fig. 1.) Fig. 2 shows the top of the table. A and B are two pieces of mahogany, 1 ft. by 2 in., and 1 in. thick, morticed together at right angles, and screwed to the top of a tripod stand, C. Into the end of each are fixed two brass screws, having a circular groove turned round their necks, forming the notch in which the knife edges of the Pendulums swing, and by turning the screws, the distance from the centre can be adjusted. On the top of this is fixed a small box, 9 in. by 5 in., and 3½ in. high, so that its centre is just over the point where the arms join. This box forms the table on which the paper is laid, held down by springs. The pen is carried by two arms of thin mahogany, jointed by a metal tube fixed tightly in the end of one, the other working round it. The pen is fixed in this tube. I use a goose quill. I have tried glass tubes, but they are difficult to make and soon get clogged. Enough ink is held in the pen by a tongue of quill inside it, almost touching the point. In each arm, at the same distance, are the Pendulums, and from the centre of the table is a small screw filed to a sharp point, which works in the conical hole in the top of each pendulum rod. Thus there is very little friction, except that of the pen on the paper, which can be regulated by balance-weights. The table must be levelled by a spirit-level, and the arms which carry the pen horizontal. The Pendulums are held up by strings towards a point under the centre, and started by a trigger, by which they can be released, either simultaneously, which gives a pointed curve, or one Pendulum at any fraction of a swing before the other, by which a continuous or looped curve is produced. This would be better done by an electro-magnet, which I purpose to try. I send a set of the curves representing the intervals of the musical scale, which are as follows:—

Do.	Re.	Mi.	Fa.	Sol.	La.	Si.	Do.
1/1	9/8	5/4	4/3	3/2	5/3	15/8	2/1
Unison.	Second.	Major Third.	Fourth.	Fifth.	Sixth.	Seventh.	Octave.

That is, if one Pendulum vibrates 9 times while the other vibrates 8, they will draw a curve similar to that which can be produced optically by the vibration of two tuning-forks, whose vibrations have the same ratio, 9/8, which in music is called a Second. Equal vibrations give Unison, a curve varying from a straight line to an ellipse and a circle. If one vibrates twice as fast as the other, for which it must be ½ of its length, an octave is drawn, and so for the other curves, according to the above ratios.

Fig. 1.—Pendulum. (¼ of real Size.)

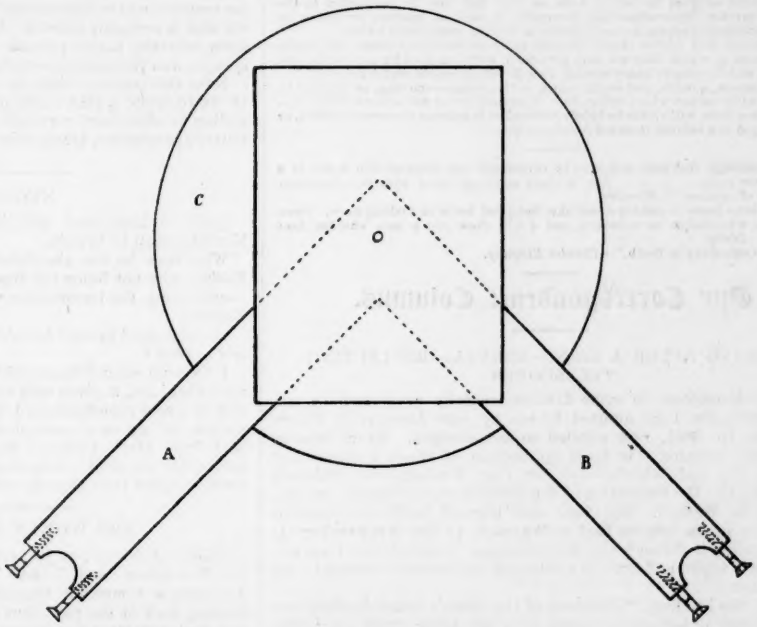


Fig. 2.—Top of Table.

There are other intermediate intervals, the curves of some of which I have obtained. One of the rods must be jointed, so that the lower half can be removed, in order to produce the higher ratios of vibration. I shall be glad to give an account of all the different curves, and the way of drawing the various forms of each, if you think it would interest any of your readers. A description of the curves, and the mathematical and musical principles involved, is given in Deschanel's "Natural Philosophy," Part I, page 848, in Jamin's "Cours de Physique," vol. ii., p. 608, and in Ganot's "Physics," p. 207, with illustrations of Lissajou's experiment for showing the curves optically by tuning-forks furnished with small mirrors and vibrating at right-angles; but I have not found any account of the method of drawing the curves by the Compound Pendulum.

E. LUXMOORE.

HEALTH OF NAVVIES.—An experience of twenty years as a medical man in India, enables me to inform "F. C. S." that betel chewing certainly does not prevent the natives from suffering severely from malarious intermittent and remittent fevers. It is an abominable habit—the lime used destroying the gums and teeth, though it, of course, supplies some want to the system, as tobacco-smoking does.—B. M., F.R.C.S.

XUM

Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

All Letters or Queries to the Editor which require attention in the current issue of KNOWLEDGE, *should reach the Publishing Office not later than the Saturday preceding the day of publication.*

(I.) Letters to have a chance of appearing must be concise; they must be drawn up in the form adopted for letters here, so that they may go untouched to the printers; private communications, therefore, as well as queries, or replies to queries (intended to appear as such) should be written on separate leaves.

(II.) Queries and replies should be even more concise than letters; and drawn up in the form in which they are here presented, with brackets for number in case of queries, and the proper query number (bracketed) in case of replies.

(III.) Letters, queries, and replies which (either because too long, or unsuitable, or dealing with matters which others have discussed, or for any other reason) cannot find place here, will either be briefly referred to in answers to correspondents, or acknowledged in a column reserved for the purpose.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"There is no harm in making a mistake, but great harm in making none. Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

"God's Orthodoxy is Truth."—*Charles Kingsley.*

Our Correspondence Columns.

SEEKING AFTER A SIGN.—ERRATA.—REFLECTING TELESCOPES.

[346]—Equations, in some fashion mentally associated by me with curves, are, I am amused to see by your Answers to Correspondents (p. 365), now applied to tavern-signs. As a humble contributor towards this fresh application of them, I would say that the Pig and Whistle = (*a*) the Pige Washael (the Maiden's Greeting; *i.e.*, the Salutation of the Virgin) of the Danish; or (*b*), the Peg in Wassail. The Bear and Ragged Staff = the heraldic cognizance of the famous Earl of Warwick ("The King-maker"), who inherited it through the Beauchamps. I regret that I am not up in the Magpie, and am—in cricketing parlance—"stumped" by his adjunct.

Albeit, the heading, "Diameter of the Moon's image in the focus of a 42-inch object-glass," appears to my letter (293) on p. 387, the paragraph to which it refers seems to have dropped out. [The correction made elsewhere; heading should also have been omitted. —ED.] The compositor has not been very kind to me in the letter referred to. For example, in my first paragraph, where "Sheppey flints" should be "Sheppey fruits;" and "sulpherised iron," "sulphuret of iron." By-the-bye, in the new nomenclature this is called Ferric sulphide.

Mr. Jones (Query 281, p. 390) had very much better get a silvered glass reflector, than a metal one.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

THE CAT'S-EYE TIMEPIECE OF THE CHINESE.

[347]—The paragraph on this subject (p. 343) reminds me of what Herodotus says (Book I., 10) about the cat among the Egyptians:—"They say that the male cat changes the shape of the pupils of his eyes according to the courses of the sun; for, in the morning, at the rising of the god, they are dilated; in the middle of the day they become round; and about sunset become less brilliant. Hence, also, the statue of the god in the City of the Sun is of the form of a cat." In the Egyptian Ritual (ch. 17), one of the transformations of the solar god is into a cat. As such, he "makes the likeness of Seb," or Time. In Egyptian, the cat is Ma, Man, or Mai (an inner African name for the animal, by-the-bye, as Mai in Undaza, with barianta in other dialects) and the same word signifies the eye, sight, and to see; Chinese Meih, to see, to seek with claws! Mâ (*Eg.*) the name of the cat, also means truth, that which is true, Mâ being the Goddess of Truth and Justice. Now time is that which is true, nor shall we get a more appropriate origin for the word time, or tempus, than Ma the true—she who, as *Tema*, supplied the Greek Themis. Tema is *the* Mâ, the true, the manifestor of truth; but it is equally *the* cat, whose eye was held to tell true in the matter of time, and whose type was assumed by the God Ra as the likeness of Time, or Seb-Kronus. Lastly, "Adene is the name of the Mother-goddess of Time" (Ritual, ch. 165).

GERALD MASSEY.

TELESCOPES, &c., ON THE THREE YEARS' SYSTEM.

[348]—It has been suggested in these pages that it would be a boon to many an honest science lover if such goods as microscopes, telescopes, &c. (good ones of which are far too expensive for a great many who would much like to become possessed of them, to purchase), if opticians could make it profitable to themselves to sell their instruments on a plan after the three years' system. I know an excellent firm, who are willing to adopt the system, if they can devise a plan whereby the risk of loss and nonpayment from dishonest persons may be reduced to a minimum. Since scientific apparatus is so much more portable than pianos and the like, which are now sold on the three years' system (and apparently with profit), the risk is certainly greater; but surely there is a plan, if only hit upon, whereby honest persons may be benefited by the three years' system, and the attempts of dishonest persons to ill-use it thwarted. It is for this reason I write to ask the help of the readers of KNOWLEDGE to devise a plan whereby it may be safe for opticians who are willing to adopt such a system of trading. Will readers, with the Editor's permission, kindly think and suggest something satisfactory?

F. C.

NEOLITHIC MAN.

[349]—I have read with interest Mr. Grant Allen's article on Neolithic man in Britain.

Why does he use the form Euskarian? If he does not say *Euskal*, why not follow the Basques themselves and say *Euskarran*? —*arra* being the termination which means people, as *Espanarra* = *Español.*

Is there good ground for stating that the Euskarran skull is long and narrow?

I have no acquaintance with the stripped skull, but, as clothed with flesh, &c., it gives both to the eye and to the hand the impression of great roundness, and it is certainly neither so long nor so narrow as my own head-piece, though I am descended in large part from black Celts of Southern Ireland, and possess, along with other physical characteristics of the race, a complexion some shades darker than that of nine Basques out of ten.

M. S.

ARE WOMEN INFERIOR TO MEN?

[350]—A friend has just sent me your very interesting journal for December, and I have read the letters in reply to M. Delaunay's somewhat ungallant pamphlet on womanhood. In looking back at the past, it is easy to see that man alone possessed any real incentives for the exercise of the intellectual faculties. It was his to fight, to exercise his utmost ingenuity, to hunt, to outwit his foes, to protect his family, to win a mate for himself; and in all this long struggle into the very moderate degrees of civilisation attained by the great nations of the world, still always engaged in warfare, woman had naturally to fill a very secondary place.

But as a higher and more refined view of life, of the purposes of man's existence in the world, of the relations between the sexes, is recognised, so will the survivals of these conditions of the past which meet us in the form of legal and social disabilities, tend to become unsatisfactory, and finally obsolete. As soon as men and women both recognise that they exist as such by the reign of a great and most useful law—one, indeed, without which progress would have been impossible—and that woman was not created specially for man, they will realise that freedom for woman is the best and safest guide for the future. Men and women represent different principles, meant for complete development; and in a very high state of civilisation, the qualities both possess are required in nearly all things in active co-operation. Man is the tree, woman the flower, and, when fully understood, they are too closely united to admit the question of the latter's "inferiority."

If, in educational systems, boys and girls more frequently studied together in classes, it would do much to refine the ideas of men with regard to women in early life, and introduce healthier feelings of sympathy and friendship between them. They have at present far too few interests in common. I need hardly say I am wholly

opposed to the methods of education prescribed by "Susan G." (in KNOWLEDGE of Dec. 2), who has spoiled an otherwise good argument, so far as it goes, by her singular advocacy of "physical force." Physical force is *ceasing* to do the world's work; thought is becoming everywhere more and more the mighty motive-power. When the great underlying principles of nature are fully realised, and the possibilities which reside in the being of man, as nature's great representative, the freedom and equality of the sexes will no longer even be questioned. By forcing his way into the realm of thought, man has really opened the door for the attainment of perfected womanhood. SUSAN E. GAY.

VENTILATION BY OPEN FIREPLACES.

[351]—I maintain, and can prove, that the "fire-hole" which Mr. Mattieu Williams wants to stop up, admits of a room being made uniformly warm and well ventilated at a small cost, better than any other means known at present. But it is essential that the room have a direct air-supply. If this be delivered into the room by a tube or tubes of not less than 48 square inches sectional area, at, or near to, the mantel, and directed towards the ceiling, the "fire-hole" will draw from the upper part of the room, the occupants will have a continuous supply of fresh air, and the floor will be warm. There should be the means of warming the direct air-supply; several forms of open grate are made which do this. In the winter there is a clamour for warmth, but during the greater part of the year it is ventilation that is wanted. F. LLOYD.

[So far as my experience goes, we suffer much more from bad ventilation in winter than when the weather is tolerably warm.—ED.]

THE PHYSICAL APPEARANCE OF SATURN.

[352]—In your "Other Worlds than Ours" you show, by the violent changes in Jupiter's cloud-belts, that that planet is most probably a glowing mass, bubbling and seething with the intensity of the primeval fires. You state in the same work that the belts of Saturn resemble those of Jupiter in general shape and in colour, and also that his belts change in aspect much as Jupiter's have been observed to do. The great diversity in the appearance of Jupiter's belts in numerous drawings seems to quite bear out your conclusions as to that planet. But I am anxious for further information before I can hold your views respecting Saturn with the same confidence. Almost every picture of the latter planet (including the exquisite painting in your "Other Worlds") represents it with belts almost as even in outline as if they had been turned in a lathe—an appearance not at first sight, at all events, indicative of violent atmospherical disturbances. In "Guillemin's "Heavens," however, there is a drawing of Saturn with irregular belts, as seen by Bond in 1848, and if the majority of the pictures of the planet possessed this characteristic, as those of Jupiter do, I should feel no difficulty in adopting your conclusions about Saturn's condition. If you would kindly clear up this matter for me, I am sure many of your readers would be greatly interested. MORE LIGHT.

[Remembering that Saturn is so much farther away than Jupiter, and so much more faintly illuminated, it is not surprising that the same telescope which shows irregularities in Jupiter's belts will reveal none in Saturn's. Speaking roughly, we receive from a square mile near centre of Saturn's visible surface only about a sixteenth of the light we receive from a similar portion of Jupiter's. But with high powers, not only are irregularities seen, but rapid changes have been witnessed, in the Saturnian belts.—ED.]

A NEW FORM OF ELECTRICAL ACCUMULATOR.

[353]—Seeing an account of Faure's Accumulator in this journal (No. 8, page 158), perhaps the following will not be uninteresting to the readers of KNOWLEDGE:—

Mr. Henry Sutton, of Ballarat, Victoria, has invented a new form of electrical accumulator, consisting of a copper cell containing an acid solution of sulphate of copper (blue stone), in which is immersed a plate of amalgamated lead, but not in contact with the copper. On connecting the accumulator with a battery or dynamo-electric machine, the copper solution is decomposed, metallic copper being deposited on the copper cell, and the lead plate is coated with peroxide of lead. When the solution becomes colourless, the cell is ready for use.

This cell is much smaller than a Faure or Planté cell of the same power, is very constant, and the inventor has generously placed it at the disposal of the scientific world free from all patent rights.

A cell, 6 inches square and 2 inches wide, was exhibited by Mr. E. Davis, at the Liverpool Chemists' Association, Feb. 2, which heated to whiteness and finally fused a thin platinum wire, and also worked a small Ruhmkorff's coil. (*Vide Pharmaceutical Journal.*) H. P. COOPER.

THE RADIOMETER.

[354]—Your correspondent, Mr. Gladstone (298), is, apparently, not aware that the motion of the radiometer is due to rays of heat, not light. This was, I believe, first noticed by Mr. Preece, and may be proved by the following experiments:—

1. Hold a sheet of thin white note-paper between the light and radiometer; the paper, being transparent, allows light to pass but cuts off the rays of heat; no movement ensues.

2. Take a sheet of very thin ebonite, which will stop every ray of light, but, being diathermanous, allows the heat to pass, and the radiometer moves round merrily.

Other similar experiments may be made by interposing a glass trough filled with sodium dissolved in bisulphide of carbon, and another with alum in water.

Wimbledon. WILLIAM IRVING PAGE.

SOCIAL INFLUENCE OF WOMAN (273).

[355]—"E. Burke" says, "Name a nation where women are debarred from social influence, and you have named one which is proportionately backward in liberty and knowledge." I take up the challenge, thus: I suppose that "E. Burke" will allow that, in respect alike of "liberty" and of "knowledge," the Athenians of old excelled their rivals, the Spartans. Yet Professor Mahaffy, in his "Primer of Greek Antiquities," writes as follows (p. 45):—"We do not find that any Greek valued her high qualities for these important duties rightly, except the Spartans. For among them alone we find the mistress of the house a person of real importance, appearing when she chooses in public, and even offering an opinion which is respected on public affairs. In cultivated Athens, on the contrary, she was only taught spinning and cooking, and what rude medicine might be wanting for the treatment of her household in trifling illness. . . . Thus the liberty of women varied from a freedom as great as need be in Sparta, to a life of seclusion and neglect at Athens." E. D. GIRDLESTONE.

THE LANK YANK.

[356]—Mr. Mattieu Williams, in his paper on "The Air of Stove-heated Rooms," in your issue of the 3rd instant, gives it as his opinion that "the lank and shrivelled appearance of the typical Yankee" is due to the dryness of his native climate, and to the further dessication (or rather increase of capacity for the absorption of water-vapour) of the air caused by stove-heating. I should like to know how he reconciles with this theory the generally well-favoured and rosy appearance of the Canadians. Surely their climate cannot be considered so much more humid than that of the Yankee, with his great extent of seaboard, as to account for their marked difference in looks. He seems, too, to have overlooked the fact that in American and Canadian houses heated by stoves there is almost universally a steam-generator of some sort (usually a pan of water on the stove), which counteracts to a great extent the avidity of the air for water. Out of doors, too, the temperature being so low (often below zero), the capacity of the air for water must be very small, and the dessicating effect scarcely perceptible.

Would it not be much more natural to account for "the lean and shrivelled aspect" of the Yankee by reference to his habit of life and, specially, of feeding, so very different from the roast beef and plum pudding of the Britisher; while, on the other hand, the Canadians, who still keep to the English way of living, have not lost the jolly and comfortable appearance of their forefathers.

I might add, too, that the Swiss and Germans, whose houses are nearly all stove-heated, and without the advantage of steam (for I never remember seeing water-pans on their stoves), are by no means a meagre or lanky race. CANADENSIS.

THE CALIGRAPH.

[357]—I can furnish "Clericus" with any information he may desire regarding an improved type-writer known as the Caligraph, with which, by the way, a recent communication of mine to Mathematical Queries in KNOWLEDGE was written.—W. W. BEMAN.

Anne Arbor, Mich., U.S.A., Feb. 23, 1882.

EYESIGHT OF DOGS.

[358]—I had not the good fortune to be a subscriber when the article in KNOWLEDGE on the near-sightedness of dogs appeared, but I have observed this peculiarity. A month ago my brother and

XUM

I were out shooting; we parted in the middle of a large field, I homeward with the dogs, he to a corner of the field where was a likely lying place for snipe. A snipe rose and he fired; one of the dogs bolted away from me, but instead of running straight to my brother, who could easily be seen, and the smoke of whose gun was still conspicuous, the dog ran back on my track till he came to where we had parted before, and then followed up my brother's track till he reached him. This dog was a retriever.—Clare.

Queries.

[335]—Tricyles.—Will Mr. Browning kindly say if he knows the "Edinburgh," and will he point out what he considers its faults?—F. H. S.

[336]—"In Memoriam."—Can you kindly tell me to whom Tennyson refers in the opening stanza of this poem?

> I held it truth, with him who sings
> To one clear harp in divers tones,
> That men may rise on stepping-stones;
> Of their dead selves to higher things.

I have been trying to ascertain for fifteen years past, and I thought Goethe was intended, but now Dr. Gatty tells me that the poet cannot be identified. On p. 94 (Q. 54), you ask if the stanza containing the allusion to "the crimson-circled star" is not LXXXIX.? In my edition (17th), it is LXXXVIII., but Tennyson has inserted an additional stanza about the yew-tree in the later editions, between XXXVIII. and XXXIX.—E. C. Malan.

[337]—Self-Acting Blowpipe.—While cleaning a small tin spirit lamp, I removed the brass top, together with the wick. A small quantity of spirits remained in the lamp, and a few drops stuck to the opening. On applying a light and inverting the lamp, a flame nearly three feet long rushed out with great vehemence, accompanied by a loud and gradually increasing roar. At this pleasing stage of the experiment the lamp became uncomfortably warm, and was promptly dropped, when the flame instantly vanished. Could a modification of the above be used with safety as a blowpipe? Perhaps some of your readers who are insured will kindly carry the experiment a step or two further.—J. H.

[338]—The Breaks in the Singing Voice.—Can any of your readers give a scientific explanation of the breaks in the human singing voice, of their cause and cure? Can they, at the same time, name a few really scientific works bearing on the subject.—Musicus [Manchester].

[339]—Euskarians.—Can Mr. Grant Allen tell us of any Euskarian words to be found in Welsh or Irish? Surely some—names of places, at least—should be traceable by their resemblance to Basque words.—S. C. Wood.

[340]—Calculating Machines.—I shall feel much obliged if any of your mathematical readers will kindly give a description of the various machines which have been invented, also those at present in use. I possess Palmer's disc, improved by Fuller, but find it inaccurate. How can I measure a logarithm on a circle or a plane? Is there any book on calculating machines and their construction? Does the Clearing-house make use of any mechanical contrivance for computing mileages?—Inquirer.

[341]—Can any one give me a recipe to prevent incrustation on the inside of a boiler of about 20 horse-power?—G. Roberts.

Replies to Queries.

[274]—Drawing.—"Eozoon's" query is too vague to admit of a definite reply. There can be no better elementary training for the eye and hand than to copy carefully the free-hand series, in all its grades, of the South Kensington School of Art. For simple objects, there is an excellent series published by Seeley & Co., of Fleet-street, and called, I think, "First Steps in Art." After this, Vere Foster's and J. D. Harding's are good for pencil, Leitch's for water-colour. The rules of perspective for landscape are very simple, and come almost intuitively. But there is—happily for the struggling artist—no royal road here, any more than to the acquisition of a foreign language—"French in six hours" notwithstanding.—R. S. Standen.

[274]—Foraminifera of Chalk.—Let "Eozoon" take a piece of chalk, and with a soft tooth or nail-brush brush it under water, and then wash the sediment well till the water is not coloured, when the residue will be nearly all foraminifera.—John G. Patterson.

[285]—Scientific Terms.—"Prester W." may find the following technical vocabularies of use:—For geology and physical geography, "Handbook of Terms," Blackwood & Sons; about 6s. For botany, natural history, anatomy, medicine, and veterinary surgery, Stormonth's "Manual of Scientific Terms," Maclachlan & Stewart; about 7s. 6d. For botanical terms, Mr. C. Cooke's "Manual of Botanical Terms," Hardwicke. General—1, Dr. Henry's "Glossary of Scientific Terms," Smith, Elder, & Co.; 2, Dr. Nuttall's "Dictionary of Scientific Terms," Strahan & Co.; about 5s.—R. P. Porter.

[286]—Electricity.—"W. H." will find the simplest and best text-book on electricity and magnetism is Noad's "Text-Book of Electricity," revised by W. H. Preece, price 12s. 6d.; published by Crosby, Lockwood, & Co., London.—S. Francis.

[287]—Dr. Ferrier's formula to cure a cold in the head is:—℞ Hydrochlorate of morphia, 2 grains; acacia powder, 2 drachms; trisnitrate of bismuth, 6 drachms. Of this powder, a quarter to a half may be used as snuff in the course of the twenty-four hours. Each time the nostrils are cleared another pinch should be taken. Use a snuff-spoon, and sniff up forcibly. The above is most useful in nasal catarrh, but may not have much effect in influenza. Instead of the 2 drachms acacia I have found 1 drachm acacia and 1 drachm starch in powder less sticky, and I think better than the original formula.—A Former Sufferer.

[289]—"The Burial of Moses" is by C. F. Alexander. It is to be found in "Lyra Anglicana," published by Houlston & Wright.—B. J. Grosjean. [Also, apparently, to be found in a number of works. Answered by nineteen correspondents, who mostly give different references. We cannot insert all.—Ed.]

[291]—Razor.—Because the heated metal causes swelling or expansion of the skin and hair cylinders, and thereby brings them into closer adaptation to the cutting edge of the razor.—K.

[292]—Silver.—Precipitate the silver as chloride by adding to the baths common salt. Well wash the precipitate, and place it in a glass vessel with a few scraps of metallic zinc and a little dilute sulphuric acid (5 per cent.). The silver chloride is speedily reduced to metallic silver (a bronze powder), which can be well washed, and then dissolved in nitric acid to form the nitrate again. Another method is to fuse the chloride obtained as above with carbonate of soda and charcoal at a good red heat. A button of silver is then obtained. Fire-clay crucibles can be bought for a few pence, *i.e.*, from 1s. per dozen upwards. Griffin & Co., of Garrick-street, W.C., or any other chemical instrument makers, would supply them.—Pharmacist.

[292]—Treatment of Silver Residues.—Best method; add to the residues hydrochloric acid in excess to throw down silver chloride; warm, filter, and thoroughly wash the precipitate; dry at gentle heat. Mix with twice its weight of dry sodium carbonate, and one-tenth as much potassium nitrate, with a little borax as flux. Heat a small clay crucible (an ordinary fire may be used); when red-hot, throw in the mixture gradually with an iron spoon, urging the heat with pair of bellows. Stir to prevent frothing; when completely fused, heat a little longer, and pour out on piece of slate. It is well to purify by remelting in a clean crucible with a little borax. The ingot of silver may be boiled in dilute nitric acid till dissolved, the solution evaporated down, and left for silver nitrate to crystallise out. Metallic silver *can* be obtained without using a crucible, by setting up a galvanic action with zinc and dilute sulphuric acid, when metallic silver (black or grey) is precipitated from the silver chloride; but I must warn F. A. B. that the difficulty of avoiding organic impurities and nitro-compounds renders this method unfit for such delicate work as photography. Crucibles may be obtained for 3d. each at any chemical apparatus manufacturers, such as Townson & Mercer, 89, Bishopsgate-street Within.—C. Harris.

[292]—Silver.—This would take two much space to answer here, but F. A. B. will find full particulars in a book published by Hockin & Co., 38, Duke-street, Manchester-square, called "Practical Hints on Photography." Crucibles can be obtained from 4d. per doz. up to 2s. 6d. each.—Alpha Centauri.

[299]—Magic Lantern.—Certainly it is possible. Get to see a lantern, and copy the woodwork; but that is the *least* important part. You had better purchase "Chadwick's Magic Lantern Manual," price 1s., but don't have anything to do with the patent gasholder described in it.—Lewis Arundel.

[301]—Magic Lantern.—An ordinary 3½-in. lantern is what you want. But get "Chadwick's Magic Lantern Manual," price 1s. He is rather good on scientific projections.—Lewis Arundel.

[302].—Vegetarianism.—Mr. J. A. Ollard should obtain publications of the Vegetarian Society (sent free to any address on receipt of post-card by the Secretary, 56, Peter-street, Manchester), and "The Penny Vegetarian Cookery," or "How to Spend Sixpence," price 1d. each.—G. C.

[302].—Vegetable Food.—Sir Henry Thompson's "Food and Feeding."—K.

Answers to Correspondents.

*** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *No queries or replies savouring of the nature of advertisements can be inserted.* 4. *Letters, queries, and replies are inserted, unless contrary to Rule* 3, *free of charge.* 5. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 6. *Each letter, query, or reply should have a title, and in replying to letters or queries, reference should be made to the number of letter or query, the page on which it appears, and its title.*

W. S. JACKSON, C. R., and others. Seventeen correspondents already have "raved" against magic squares. We therefore must not insert anything more about them for a good while. Mr. Miles, however, will willingly, I doubt not, say where Poignard's method first appeared.—THREE CHRONOS. Surely you are the ones to answer what you call the "rum watch query."—TARANAKI. The horizon sinks as we rise above the earth's surface; but the dip is very slight, even for a considerable height. The eye cannot detect it readily, even from a height of four or five miles.—A. P. M. Your letter about weather forecasts is long, but we will try to find space for it.—E. S. KENNEDY. Sayce's writings on Assyrian literature contain a good deal about the star-worship of the Assyrians. Published, I think, by Bagster.—E. KELLY. You will not find that Newcomb attributes the acceleration of the moon to the tidal wave. He says that a part of the acceleration is explained by the effects of the tidal wave in retarding the earth's rotation.—CLEMENT W. JEWITT. Cannot identify the year when "two comets came in (some time about 1858)."—J. THRUSTAN calls attention to the fact that the barometer, after being abnormally high for several weeks, fell rapidly on February 25th, yet there were no explosions in coal-mines, as predicted by Mr. R. C. Rapier.—SCRUTATOR. Let P be the length of a perpendicular let fall from one angle of a tetrahedron to opposite *face*, and let p be the length of perpendicular from an angle to opposite side of any face including the angle, and let s be length of a side. Then we know that

$$P = \sqrt{s^2 - \frac{s^2}{4}} = \frac{s}{2}\sqrt{3};$$

and

$$P = \sqrt{p^2 - \frac{p^2}{9}} = \frac{p}{3}\sqrt{8} = \frac{s}{3}\sqrt{6} = s\sqrt{\tfrac{2}{3}}$$

and the centre of the tetrahedron lies on each of the perpendiculars from the angles on opposite faces, at a distance $\frac{P}{4}$ from each face, of $\frac{s}{4}\sqrt{\frac{2}{3}}$ from any face. If $s=16$, then this distance is $4\sqrt{\frac{2}{3}}$

J. MACKENZIE, M.D. Considering how much it is the doctor's interest to discountenance vaccination, supposing it to be really protective (as every one knows it is), you can hardly expect me to believe that doctors advance statements opposed to the truth in this matter, when they advocate vaccination. An epidemic of small-pox would be a fortune to mercenary medical men, protected themselves by vaccination. The paltry vaccination fees are as nothing by comparison with the fees they could fairly claim in the times before vaccination. If small-pox were rife in any city where you or I dwelt, should we not at once be vaccinated, and should we not then feel as safe as if there were no such epidemic? Frankly, I should consider myself a public offender if I admitted one line here in favour of the views maintained by the Society for the Preservation of Small-pox. As for what you say about Whist, doubtless many would prefer to have the space now allotted to Whist given to some other subject; all are not Whist players. But the omission of several subjects which *all* do not like might readily lead to the omission of KNOWLEDGE altogether. Every one must not expect KNOWLEDGE to be *filled* with just those subjects he may chance to like. I think we give our fair twopenny worth of science, without the Whist and the Chess.—SUSAN E. GAY. Your letter was sent at once to printers, and will appear soon.—A. H. H. My papers on Differential Calculus would probably be simpler than you would need.—DONALD KING. An article on sun spots would be necessary to answer your question; will probably have one shortly. Meantime, any good book on astronomy would help you.—H. B. LINDSAY. Part of your letter referred to F.R.A.S. May shortly write about space; but your remarks need not, therefore, be withheld. You know our requirements as to space.—J. MCDOWELL. Your name entered on list for Nos. 2, 3, and 5. You are quite right about our proposal on p. 302; we were but jesting.—F. RAM. To Darwin and Wallace, of course, is due the credit of the recognition of the accepted theory of evolution. Spencer's researches are, however, of great importance.—CARPENTER. If you really want to know its weight, put it in the scales; if you set the query as a "sum," perhaps you will explain what you mean by saying "the surface of the wet part was 209·44 inches."—INCREDULOUS. Probably, table turned by pushing; depends how it went.—Q. E. D. Hog puzzle right.—W. H. HEWETT. The conditions seem equally favourable.—SPENCER RYDER. I should imagine that you might more readily infer the existence of a God from your own personal sense of his works, than by the rather roundabout way you suggest. Does the most beautiful painting of a landscape, or the most perfect description of the glories of the heavens, give you so good an idea of the existence of a God as the landscape itself in one case, or the star-lit vault of heaven in the other?—J. A. C. OLLARD. Yes; but suppose 20,000 copies of supplement were printed, "containing letters only or chiefly," and only 1,000 were sold; how then? On the reason of animals question, what you "believe" and "do not believe," might not interest all our readers.—FINITE SPACE. Neither can I imagine space limited: nor can any one; nor can any one imagine infinite space.—C. J. TOOTELL. Thanks for picture of sun-spots, but by time it would appear they would not be there. Your method of focussing, where rackwork is not very delicate, is, I know from experience, excellent. (It is to let the eyepiece be not fully screwed "home," and then adjusting roughly by means of rackwork, to get exact adjustment by turning the eyeglass.) Only it is not safe to have the eyeglass but half screwed in; for if you have many adjustments, and a preponderance chance to be by screwing outwards, the eyeglass may fall out.—G. T. M. Both your suggestions are already under consideration. Thanks.—M. V. M. Thanks; but too long, and scarcely suitable otherwise.—H. W. *We* do not want metaphysics, melancholy though you think the future of science is to be without it.—SIRIUS. Very doubtful at present about that companion. Spectroscopic evidence shows Sirius to be probably in an earlier stage of sun-life than our own sun.—JAWGE. Dental formula: incisors, $\frac{6}{6}$; canines, $\frac{1-1}{1-1}$; molars, $\frac{7-7}{7-7}$ = 44,—means that the teeth are arranged in the two jaws, Jawge, thus:—

M M M M M M M M C I I I I I I I C M M M M M M M M
M M M M M M M M C I I I I I I I C M M M M M M M M

where M stands for a molar, C for a canine, and I for an incisor tooth.—THOMAS SMITH, Jun. Describing a man's character from his bumps is not phrenology. Study what Gall and Spurzeim really taught, and you will see what it is that science rejects.—ISHTAH. *Altruism*, derived from *alter*, "another," means the consideration of the interests of others before our own, just as *egoism* from *ego*, I, means the consideration first of our own interests.—G. T. W. M. There is a small book by Abbott, head-master of St. Paul's School, on the "Queen's English." I forget publisher's name and price.—J. H. COBBETT. You are too exacting. Parallax allows only a top to the earth, and you ruthlessly ask for a model. You might as well ask for soundings of the bottomless pit.—W. B. Thank you for reminding me; yes, the ratio of circumference of circle to radius is, as you say, fixed; but in the solution of the rod-tossing problem this constant ratio comes in with a factor which is not constant.—E. L. R. Yes; ice-particles can and do cause parhelia (not perihelia, as the *Gazette* prints it).—G. A. K. The historical value of the play called Shakespeare's Henry VI. is very small. Shakespeare wrote but a small proportion of it. As you say, the Bear and Ragged Staff were not taken by the Nevilles before their alliance with the Warwick family to which the crest belongs.—W. SUMNER. The rotation of the earth has been regarded as appreciably uniform. It is not quite so, but the variation is very slight. The question is, however, too complicated to be discussed here. It wants an article to itself.

Letters Received.

W. S. Jackson, K. Huskisson, J. H. Vulliamy, R. Tollit, Praxis, K. L. P., J. Murray, Metamorphosis, Pertinax ('Tis true, 'tis pity), Cosmopolitan, Anxious One, W. John Grey, J. H., Mongredian, Semper Paratus (so is W. P. B.), Jupiter Tonans (save us), M. Purvis, J. Harmens, F. M. Rogers, Pollaky, H. F. C., J. H. Marvin, P. Tindale, M. Morrison, K. P. M., R. Lecky, Circle-squarer, Triangular, Queer Querist, M. Rambures, S. S. T., Rev. M. M., Castrensis, Ad ardua tendo (Respice finem), C. Collins, Anti-humbug, Simplex, Verge, H. Jowett, K. Prothero.

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Our Mathematical Column.

PROBABILITIES.

By the Editor.

LET us next take a case not quite so simple as the tossing of a coin, namely, the casting of a die. We know that the chance of throwing ace in a single trial is $\frac{1}{6}$. Let us consider what is the chance of throwing ace in two trials with one die. The consideration of this will bring before us a very common mistake in dealing with chance questions, an instance of which occurred recently in the discussion of the question about cutting any one of three named cards (of any suit) from a pack, once in three trials. A correspondent asked, with reference to this question, whether, as the chance of cutting one of the cards in a single trial was obviously $\frac{3}{17}$, the chance in three trials must not be thrice this, or $\frac{9}{17}$. This is erroneous, but not very obviously so. So again in the case of a die—it is not obvious at first sight that the following reasoning is unsound. The chance of throwing ace in one trial is $\frac{1}{6}$, therefore in two trials it must be $\frac{2}{6}$, or $\frac{1}{3}$. We see, however, at once that the following reasoning is incorrect, or, at least, leads to an incorrect result, though it is precisely the same in character. Since the chance of tossing a head in one trial is $\frac{1}{2}$, the chance of tossing a head in two trials must be $\frac{2}{2}$, or certainty; for we know there is no certainty at all in the matter. Yet even here it is not quite clear to the beginner where the error comes in, and he is often inclined to think there must be some defect in our method of representing chances, when reasoning which seems correct leads to an obviously incorrect result.

Now the answer usually made to the above incorrect reasoning about the tossing of a die, runs commonly as follows:—The chance that an ace will be thrown in the first trial is $\frac{1}{6}$, but the chance that an ace will be thrown in the second trial is not $\frac{1}{6}$, because there may be no second trial, for the first may give an ace. We must, therefore, add $\frac{1}{6}$, the chance in the first trial, to $\frac{1}{6}$ (the chance in the second trial), reduced in a degree corresponding to the chance that a second trial will be required. Now the chance that there will be a second trial is, in fact, the chance that the first trial will fail to give an ace, or $\frac{5}{6}$, so that the chance of throwing ace in a second trial is not $\frac{1}{6}$, but only five-sixths of $\frac{1}{6}$, or $\frac{5}{36}$. Adding this to $\frac{1}{6}$, the chance of throwing ace in the first trial, we get $\frac{1}{6}+\frac{5}{36}$, or $\frac{11}{36}$, for the chance of throwing an ace in two trials.*

But the objection suggests itself to the student that the second trial may be guaranteed, whatever the result of the first trial. The thrower may say—to begin with—I *mean* to throw this die twice; what is the chance that one of the throws at least will be an ace?—and then the above reasoning about the contingent nature of the second throw is rendered unmeaning. De Morgan deals with this objection in a very just way, but I am not sure that his reasoning convinces all minds very readily. Todhunter, after noting the objection, says, "The error really arises from neglect of the following consideration: when events are *mutually exclusive*, so that the supposition that one takes place is not incompatible with the supposition that the other takes place, *then, and not otherwise,* the chance of one or other of the events is the *sum* of the chances of the separate events. In the present case success in the first trial is not incompatible with success in the second trial, and therefore we cannot take the sum of the chances as the chance of success in one or other of the trials." But this, after all, amounts only to a statement of the fact that that reasoning is erroneous by which the chance of throwing ace in two trials with a single die is made to be twice $\frac{1}{6}$. Now, this fact we *know*, because we see that the extension of the same principle of reasoning leads to an obviously incorrect result. What we *want* is to learn exactly where the error lies. I do not find that this is clearly shown in treatises on probability.

Let us take an illustrative case from which, as I judge, the true nature of the error may be learned.

In an urn there are six balls, marked from 1 to 6. The chance of drawing ball 1 is, of course, the same as the chance of throwing ace at a given trial with a single die; that is, it is $\frac{1}{6}$. Now suppose that six persons draw each a ball. One of them must have drawn ball 1. The chance that any one of the six has drawn this ball is $\frac{1}{6}$; and the chance that one of a given pair of these six persons has drawn the ball is $\frac{1}{6}+\frac{1}{6}$. This is clearly the case, as shown in paper I.; and that the reasoning is just is proved by the fact that when it is extended so as to include all the six persons, we get six times $\frac{1}{6}$, or unity, corresponding to the certainty that one of the six has drawn ball 1. Now the fallacy in the former reasoning about the die lies in the supposition that two throws with a single die give the same chance of throwing an ace that any pair of our six ball-drawers has of drawing ball 1. Whereas it is obvious that to represent the case of the die-throwing, we must have—*not* two different balls drawn at random from an urn containing six, *but* one ball drawn at random and replaced, and then again one ball drawn at random.

Let it be noted that there is no begging of the question here. It is certain that the chance of throwing an ace is the same as the chance of drawing ball 1 from the urn containing six. It is certain that to represent the second throw, as well as the first, the urn must have its full complement of six—that is, it is certain the ball first drawn must be replaced before the second drawing is made. Whereas it is certain that the case which gives as the resulting chance $\frac{1}{6}+\frac{1}{6}$, is the case where a ball is drawn, and then (or simultaneously, it matters not which) *another* ball.

That the two cases are distinct is rendered obvious, therefore. And not only so, but we can see which case gives the better chance. For in considering the two cases, we can place our finger on the exact spot where the chances differ. Suppose that a person A proceeds as in the former case, a person B as in the latter, each dealing with a separate urn, containing balls numbered from 1 to 6; and let us compare their chances of drawing ball 1. They begin alike. A draws a ball from his urn, and B one from his. Their chances of succeeding in this first drawing are, of course, equal: but if they fail, their chances on the second drawing are not equal. For A has to return the ball he drew into the urn again; and he will have no better chance of success at the second trial than at the first. But B retains the ball first drawn, and at the second trial he has a better chance of success than at the first; for he has to draw now ball 1 from an urn containing only five balls instead of six. But B's chance in his drawings is certainly $\frac{1}{6}+\frac{1}{6}$; A's chance, therefore, is certainly something less than $\frac{1}{6}+\frac{1}{6}$.

We see, then, that we must adopt a more trustworthy mode of reasoning in the case of successive trials under unchanged conditions.

A Pretty Geometrical Problem, and Mogul's Problem.—A great number of solutions of these problems have been received, and of the former ("Kelland's") problem a very complete discussion has been sent to us. It will be a work of some little time to analyse all the solutions, but we hope next week to give an abstract of "Mogul's" solution, and of the paper just mentioned, with suitable figures. Both problems are very instructive.—Ed.

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* What follows is quoted, with very little change, from a series of articles on the "Laws of Chance as Applied to Statistics," which I wrote eleven years ago for the *English Mechanic*, where they appeared in August and September, 1871. I shall take occasion, when convenient, to borrow passages from those articles, but with such modifications as my experience of the difficulties commonly found by students of the subject may suggest.

Our Chess Column.

How the Devil was caught. Played at Brighton, 1879.

Allgaier Gambit.

White. Mephisto.	Black. F. Edmonds.	White. Mephisto.	Black. F. Edmonds.
1. P to K4	P to K4	12. B takes P(g)	Kt takes B
2. P to KB4	P takes P	13. P takes Kt	Q to Kt6(ch)
3. Kt to KB3	P to KKt4	14. K to Bsq	Kt to B3
4. P to KR4	P to K5	15. Kt to B3(h)	Castles QR(i)
5. Kt to Kt5	Kt to KR3(a)	16. Kt to Q5	R takes Kt(j)
6. B to B4(b)	P to Q4(c)	17. P takes R	Kt to Q5!
7. B takes QP	B to Kt2	18. P to B3	P to KB4
8. P to Q3	P to KB3	19. P to Kt5	R to Ksq(k)
9. Kt to K6	B takes Kt	20. P takes Kt	B takes P
10. B takes B(d)	P to B6(e)	21. Q to K2(l)	R takes Q
11. P takes P(f)	Q to Q3	22. K takes R resigns.	Q to Kt7(ch)

(a) Not to be commended. Black only obtains a very indifferent game by this move, whereas, by the usual continuation of 5 P to KR3! he ought to get the better game, in spite of White's subsequent attack. If a player is afraid to expose himself to the attack, then the more logical course would be to refuse the Gambit from the beginning.

(b) 6 P to Q4 is the proper move here, for, if Black plays 6 P to KB3, then 7 B takes BP, 7 P takes Kt, 8 (B takes P and White wins his piece back, but we usually prefer 8) P takes P, as this sacrifice yields some interesting play.

(c) Whereas, now he might have played 6 P to KB3 and won the Knight with tolerable safety.

(d) White might also have played B takes KtP, for, although he would thus give up two pieces for a Rook, he would not have the worst of it, as he would capture the KBP and have 7 Pawns to 5 of his opponents.

(e) An ingenious conception, which attained its object, but which might have been met differently.

(f) Instead of P takes P, he should have played 11 B takes Kt! Q to Q3 for Black would not be good now, as White could safely take the Bishop, as he need not fear the series of checks with Black's Queen. 11 P takes KtP would also result in White's favour. He would move his R to Ktsq, and, in reply to B takes B, White would play Q takes KtP. The best line of play would be 11. $\frac{\text{B takes Kt}}{\text{B takes B}}$, 12. $\frac{\text{P takes P}}{}$ (better than 12 B takes P, to which Black might reply with 12 P takes P, 13 R to Ktsq, 13 Q to Q5, 14 R takes P, 14 Q takes QKtP with a fair game), 12 Q to Q3, 13 $\frac{\text{B takes P}}{\text{Q to Kt6(ch)}}$, 14 $\frac{\text{K to Bsq}}{}$, and White has two Pawns with a good defence, as he will now be able to force the Queen to retire either by playing R to R3 or Q to Ksq.

(g) Curious to say that, as we examine the position, we find that even now B takes Kt would have proved effective; in fact, White had nothing to fear from Q to Q3, for, if now in reply to 12 B takes Kt, 12 B takes B, then we have the same position as examined in our former note; or, if 12 Q to Kt6(ch), 13 K to Bsq, the tempting move of 13 P takes P for Black would be met by 14 R to Ktsq, 14 Q takes RP, 15 B to K3, and White has won a piece.

(h) If 15 Kt to Q2, then Black replies with 15 Kt to K4.

(i) This shows good judgment. He does not at once play Kt to K4, but brings his Rook into play, while White's game remains *in statu quo*.

(j) Black is playing in very good style. He obtains a strong attack by this sacrifice.

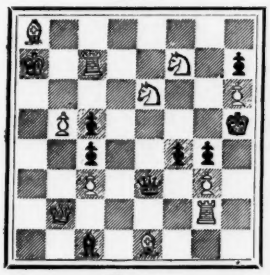
(k) Excellent play; something of Morphy's style.

(l) We don't see anything better. If Q to Q2, then 8 to B6(ch), or if Q to B2, R to K8 mate. Of course, he threatens mate on B2.

LOWENTHAL PROBLEM TOURNEY, No. II.

No. 26.
FIRST PRIZE SET.
Motto: "Peep beneath."

BLACK.



WHITE.
White to play and mate in four moves.

No. 27.
SECOND PRIZE SET.
Motto: "Too many 'Cooks' spoil the mate."

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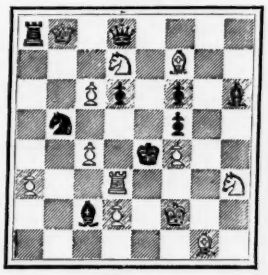

WHITE.
White to play and mate in three moves.

The following two problems have won the First Prize in the Tournament of the *Boys' Newspaper* (taken from the *Chronicle*).

No. 28. No. 29.
By G. Hume (Nottingham).

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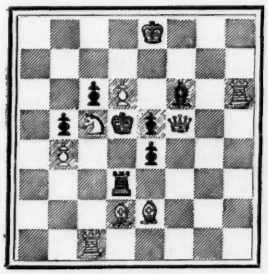

WHITE.
White to play and mate in two moves.

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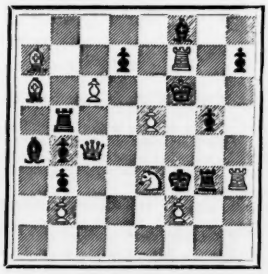


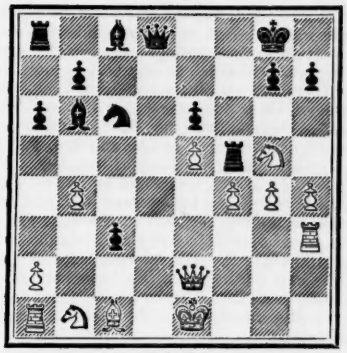
WHITE.

GAMES BY CORRESPONDENCE.—(*Continued from p. 442.*)

GAME I.

Position after White's 17th move.
P to KKt4.

BLACK
CHESS EDITOR.



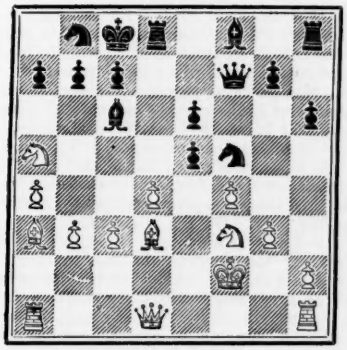
CHIEF EDITOR.
WHITE.

CHIEF EDITOR.	CHESS EDITOR.
	17. R takes Kt
18. RP takes R	18. Q to Q5
19. Kt takes P	19. Q to Kt8(ch)
20. K to Q2	20. B to Q2
21. Q to Q3	21. P to Kt3
22. Kt to K2	22. Q takes P
23. R to K Kt3	23. Q to R4
24. B to R3	24. R to Qsq
25. Q to KB3	

GAME II.

Position after Black's 15th move.
P takes P.

BLACK.
CHESS EDITOR.



CHIEF EDITOR.
WHITE.

CHIEF EDITOR.	CHESS EDITOR.
16. Kt takes KP	16. Q to B3
17. Kt takes B	17. Kt takes Kt
18. Kt takes Kt	18. P takes Kt
19. B to R6(ch)	19. K to Ktsq
20. R to Ksq	20. B takes B
21. R takes B	21. P to KKt4
22. Q to KB3	

CORRECTION.—PROBLEM No. 25, p. 441.
Remove Black Pawn on R3.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

J. A. Miles.—We have sent you your problem by post for correction.

C. H. Brockelbank.—Received with thanks.

R. G. Brothers.—We regret to see you disappointed by H. T. Holden. Have given you another opponent, J. B. Groser, who will reply to your moves.

J. B. Groser *versus* R. G. Brothers.

XUM

Our Whist Column.

BY "FIVE OF CLUBS."

I HAVE been for some time past endeavouring to systematise the play second hand, like the leads, but the task is not an easy one. To begin with, the lead is always guided by one of two considerations: it is either from strength, or, when from weakness, it is played to help partner as much as may be. In most cases it is from strength, and there can then be no question as to the card to be played, and very little as to the meaning of a card which has been played. But the second player may have strength or weakness, or neither strength nor weakness, in the suit led, and his play thus depends on a greater possible variety of positions. Then, again, it depends on the lead; so that we cannot say, as we can in the case of the lead, such and such a card means such and such a suit, but must take into account the card led in the suit. It thus becomes impossible to present anything like such simple rules, either for playing second hand, or for the interpretation of the play second hand, as in the case of the lead. Half a column on p. 310 suffices for the statement of all that need be known about the leads or their interpretation; we cannot present the rules for second play in anything like this space.

To proceed systematically, let us consider the leads as presented in p. 310, and the corresponding play of second hand. Fortunately we can dismiss a number of cases very quickly.

PLAY SECOND HAND WHEN ACE, KING, OR QUEEN IS LED (PLAIN SUITS).—When Ace is led, of course, second hand has only to play his lowest, unless he wishes to signal, when he plays his lowest but one. When King is led, second player, if he holds Ace, puts it on ("covers," is the technical expression*), otherwise plays his lowest, unless to signal—a case we shall not hereafter specially refer to. When Queen is led, we know that the leader does not hold Ace or Queen, and unless the lead is from a weak suit (a forced lead), that he does hold both Knave and ten. If second hand holds both Ace and King, he would, of course, play the King. If, of these two cards, he holds Ace and others, whether long or short in the suit, he plays the Ace. If he holds King and others, his play will depend on his strength in the suit; if short in the suit, it is better to cover; if long, to pass the Queen, playing, in fact, on the same principles which guide in leading from weakness on the one hand and from strength on the other. The play second hand when Queen is led depends on the consideration that if Ace is held by third hand, it will not be played unless King is played second hand, when, of course, it will be played by fourth hand. Now, if third player holds Ace, and second player having King is short in the suit, he can gain nothing by failing to cover. Leader will know Ace lies with third player, and will lead again (the lowest of his head sequence) when the King, if again kept back, will be unguarded, so that a third round will cause the King to fall to partner's Ace. If, however, the suit is long, this danger does not exist, and there is a greater probability that Ace will fall or the suit be ruffed early. On the other hand, if fourth player has Ace, it is still second player's interest to keep back the King if he is long in the suit. His partner will take the trick with the Ace, and whether second round is led by original leader or his partner, the King will capture another card of the head sequence, with good chance that the last will fall in the third round. If, however, second player was short in the suit, of course, he gains nothing by thus clearing it: it is best for him, therefore, to cover with King second round, even if his partner holds the Ace.

When Queen is led and second player holds King, ten, and one other, the question may arise whether it is not better to hold up the King, on the chance that partner taking trick with Ace, the return of the suit, when the leader's partner gets the lead, may find second player with the tenace. It is, however, better on the whole to cover in this case. The lead is in all probability from Queen, Knave, and one other; it is certainly a forced lead; and it is an even chance that partner holds the Ace, and also an even chance that he has numerical strength as against third hand. It is three to one that one of these conditions holds, and in either case, playing King second hand is good. If your partner holds the Ace, you and he still have the command; and if he has length, you help to clear his suit by playing the King. The state of the score may occasionally justify departure from this rule, however.

It is scarcely likely that when Queen is led, second player should hold King and Knave, with or without others, for this can only happen when Queen has been led from Queen and a small one, a lead only justified by the absolute impropriety (shown by previous play) of leading from long suit, and clear evidence that partner is strong in the suit so led. Of course, if this *should* happen, the King is played. In fact, almost invariably when second player holds—with other card—a fourchette for a high card led (that is, King, Knave for a Queen; Queen, ten for a Knave; Knave, nine for a ten; and so on) he should cover.

* I desire to call attention to the circumstance that these papers on Whist play are intended for learners, not for those who already understand Whist strategy.

Solutions of Problem 2 by Valnol, A. C. W., H. Barclay, Peter Parley, M. Morrison, correct.

G. THOMPSON.—Sorry we misled you with Problem 2; we leave it open another week.

W. F.—You are right on one point; in lines 13, 15, and 16 for *Z* read *B* (hardly worth correcting, being so obvious). But you say: How can (meaning, perhaps, *why* should) *B* now ruff? *Y* has no means of knowing that *A* holds the winning Heart after Ace, viz., the ten, and we are considering the second and third round from *Y*'s standpoint. Of course, *B* would not have trumped his partner's winning card. Again, you say, How should *B* win the second round with a trump? How or why should he *not*, had *Y* put on a small trump, as he ought to have done?

T. F. gives the following question:—

"How many different hands may a person hold at a game of Whist?" His answer is 635,013,559,600; but this is open to question. Is it the same hand, for instance, when same cards are held, but trump suit is different? or whether holder of hand is dealer or not? or leader or not? or if, being dealer, *any* card of the thirteen be supposed the trump card? Whist players would answer No to all these questions. FIVE OF CLUBS.

DEAR FIVE,—I was shown the subjoined Double-Dummy Problem by a fellow-passenger from Wellington to Napier (New Zealand), last year. No doubt it has been published, and you or one of your Whist correspondents can tell me where and when. But it seems to me (I speak under correction) a good problem.—Yours, &c.,

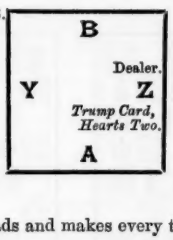
EDITOR.

PROBLEM 3.—Double Dummy.

THE HANDS.

A.
Hearts—A, Q, 10, 9, 4, 3.
Clubs—10, 6.
Diamonds—3.
Spades—10, 9, 8, 7.

B.
Hearts—Kn, 6.
Clubs—5, 3, 2.
Diamonds—A, Q, Kn, 6, 5.
Spades—A, Q, Kn.



Y.
Hearts—K, 8, 7.
Clubs—9, 8, 7, 4.
Diamonds—2.
Spades—6, 5, 4, 3, 2.

Z.
Hearts—5, 2.
Clubs—A, K, Q, Kn.
Diamonds—K, 10, 9, 8, 7, 4.
Spades—K.

A leads and makes every trick.

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